Ovation I/O Reference Manual
REF_1150

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SECTION 1

INTRODUCTION TO THE OVATION I/O REFERENCE MANUAL

IN THIS SECTION

What is the purpose of the Ovation Input/Output Modules? *1*
Description of Terms *2*

1.1 WHAT IS THE PURPOSE OF THE OVATION INPUT/OUTPUT MODULES?

The Ovation Distributed Control System provides modulating control, sequential control, and data acquisition for a variety of system applications. This system consists of a configurable mix of functional Input/Output (I/O) modules that communicate on the I/O bus to the Ovation Controller.

I/O modules provide an interface between the Ovation Controller and the processes in the plant. Ovation I/O modules are “plug-in” components with built-in fault tolerance and diagnostics. They are able to operate on a wide range of signals and perform a multitude of functions.

The Ovation I/O modules are locked into base units. These base units are housed in the Controller cabinets where they are mounted on DIN rails and wired to the appropriate field devices.

The standard modular components typically consist of the following:

- Electronics module (Emod)
- Personality module (Pmod)
- Base Unit (containing the field terminations)

The relay output modular components consist of the following:

- Electronics module
- Base Unit (containing the field terminations)

The following information describes the I/O modules and their usage in the Ovation system.

Detailed information about Ovation cabinets can be found in the applicable Planning book. (See *Planning and Installing Your Ovation System.)*

1.2 DESCRIPTION OF TERMS

The following table lists some terms that are used to describe the Ovation I/O.

Descriptions of I/O Terms

TERM	DESCRIPTION
AUI Cable	Attachment Unit Interface (AUI) Cable that interfaces the PCRR card to the MAU module in remote I/O applications.
A Side	Refers to the left side board-to-board connector of the base unit when the terminal block or AUI Cable connector is facing the viewer.
B Side	Refers to the right side board-to-board connector of the base unit when the terminal block or AUI Cable connector is facing the viewer.
Base Unit	Consists of a printed circuit board, various connectors, and plastic housing. It provides a mechanism for the user to land field wiring, and connects the field signals to the I/O module. The unit enables the I/O module to receive power, and also provides a low-impedance earth ground connection. Each standard base unit can house two sets of I/O modules, along with the associated field wiring. The Relay Output base unit houses one Electronics module.
Branch	Set of base units configured consecutively on a DIN rail with a local bus being connected to the I/O Controller.
Electronics Module	Portion of an I/O module that provides a plastic housing with associated lenses and labeling. It contains up to two printed circuit boards (the logic board and field board) that provide the electronics necessary to interface the field devices with the I/O Controller.
I/O Controller	Interface between the Network and the I/O. The Controller is located in the Ovation I/O cabinet. (See *Planning and Installing Your Ovation System*.)
IOIC Card	Generic name for the Controller PCI I/O Interface card. Options are PCQL, PCRL, PCRR.
I/O Module	Standard I/O modules are made up of an Electronics module and a Personality module. Compact modules and Relay Output modules do not contain a Personality module. These modules perform the interface between the I/O Controller and the field devices.
MAU	Media Attachment Unit (MAU) is an alternate name for the Attachment Unit Module and includes the Electronics module and Personality module combined. This device interfaces the PCRR card (via the AUI cable) to the RNC (via fiber-optic cable) in remote I/O applications.
Migration	Process used to interface an Ovation Controller to WDPF Q-Line I/O.
Ovation Network (Data Highway)	Local area network in which Ovation drops communicate with each other through FDDI, CDDI or Fast Ethernet media.
PCI	Peripheral Component Interconnect (PCI). Main bus used in the Controller for communication between the Controller CPU network interface and I/O Controller modules.
PCQL	IOIC card in the Controller that interfaces to local Q-line I/O.
PCRL	IOIC card in the Controller that interfaces to local Ovation I/O.
PCRR	IOIC card in the Controller that interfaces to remote Ovation I/O and remote Q-Line I/O in migrated systems.

TERM	DESCRIPTION
Personality Module	Portion of an I/O module that provides a plastic housing with associated lenses and labeling. It contains a printed circuit board to perform the necessary signal interconnections required for interfacing the I/O modules to particular field devices. Typically, the module contains only passive components, but the Media Attachment Unit module and Remote Node Controller module contains fiber-optic transmitters, receivers, and transceivers in their Personality modules. The Link Controller I/O module contains optical couplers and RS-232/RS-485 transceivers in its Personality module. The module plugs directly into the base.
QOR Card	Remote Q-Line card (housed in a remote node Q-Crate) that permits WDPF remote nodes to be interfaced to an Ovation Controller, using fiber optic cable, an MAU, and a PCRR card in the Ovation Controller. (See *Remote Q-Line Installation Manual*.)
Remote I/O	A configuration where the I/O is located remotely from the Controller.
Remote Node	A grouping of I/O modules that communicates with the Controller via media that can carry control signals over a long distance (for example, fiber-optic).
RNC	Remote Node Controller (RNC) is an alternate name for the module containing the Remote Node Electronics module and Remote Node Personality module. The RNC interfaces the I/O modules in the Remote Node to an MAU module at the Controller via a fiber-optic communication link.
Transition Panels	Types are: ROP - I/O transition panel TND - Remote Node transition panel RRP - Relay Base transition panel (top location) RRB - Relay Base transition panel (bottom location)

SECTION 2

NOISE MINIMIZATION TECHNIQUES

IN THIS SECTION

What are the Causes of Electrical Noise? *5*
Noise Discrimination *6*
Noise Sources *8*
Noise Classes *8*
Noise Rejection *9*
Analog Signal Shielding Techniques *12*
What are some Common Input Considerations? *14*

2.1 WHAT ARE THE CAUSES OF ELECTRICAL NOISE?

A wide variety of analog and/or digital circuits are associated with the Ovation System's installation. There are low-level voltage circuits, high-level voltage circuits, circuits that transfer information, and circuits that transfer power. These circuits are placed into two categories: noise-producing circuits and noise-sensitive circuits.

Noise problems typically occur when transmitting analog (voltage, current, and other measured values) or digital information (on/off conditions, pulse trains or similar data) via inter-connected or wired circuits. The information carried by signals in such circuits may become distorted during transfer and errors may result from this distortion.

The difference between the signal of transmitted information and the signal of that information as received is called **noise** (see the figures in Energy Level (see page 6) and Frequency (see page 7)). The noise minimization techniques briefly described in this section focus on preventing errors by either eliminating the noise, or when elimination is not possible, performing steps to lessen its impact.

The following topics discuss the causes of electrical noise in your Ovation system and the recommended techniques for eliminating or reducing that noise.

- Noise Discrimination (see page 6).
- Noise Sources (see page 7).
- Noise Classes (see page 8).
- Noise Rejection (see page 9).
- Analog Signal Shielding Techniques (see page 12).
- Common Input Considerations (see page 14).

2.2 NOISE DISCRIMINATION

Natural signal properties (such as the peaks of a digital signal) or conditions created during signal transmission (such as the voltage of the analog signal) are used to make the desired information in the signal appear different from the noise. The recovery of correct information from a noisy signal therefore depends upon the ability to subtract the noise from the desired information.

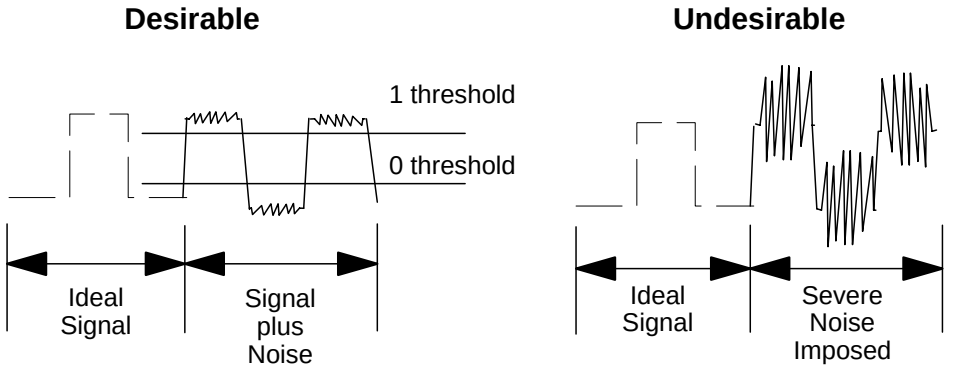
Three components of a signal that can be used to separate the desired information from a noisy signal are:

- Energy Level (see page 6).
- Frequency (see page 7).
- Noise Sources (see page 7) (of both Signal and Noise).

The following information explains how each of these components can be applied to minimize errors that may occur because of a noisy signal.

2.2.1 ENERGY LEVEL

The energy level is the total energy for the signal plus any induced noise. If there is a significant difference between the signal and the noise, then the noise is rejected easily by thresholding techniques (as identified as Desirable in the following figure). If there is not a significant difference between the signal and the noise, then the noise is not easily rejected (as identified as Undesirable in the following figure).



Threshold discrimination is possible because of sufficient contrast between noise and signal amplitude.

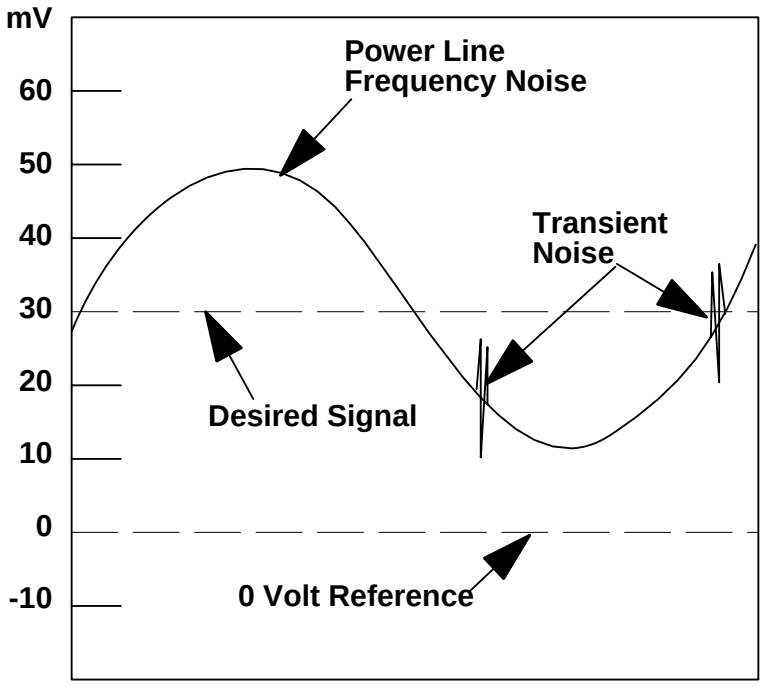
The noise and signal have insufficient amplitude contrast to permit simple threshold discrimination.

Figure 1: Amplitude Discrimination Example

Frequency

Most of the noise commonly encountered in industrial plants is related either to the **power line frequency** and its low harmonics, or to **switching transients**. The analog signals are usually lower in frequency than one cycle per second, while the digital signals between plant and Controller appear from zero to millions of cycles per second.

Both analog and digital signals can be discriminated easily by eliminating frequency content from external noise sources, such as switching transients, since the transients do not contain appreciable energy below 0.5 MHz frequency. Low pass filtering is useful in recovering analog signals from either power line or transient noise and for recovering digital signals from transient noise. The following figure shows an example of these two types of noise.



The signal above is shown at a 30mV level with both 14 mV RMS (60 Hz) and transient noise.

Figure 2: Typical Noisy Signal

Sources (Signal and Noise)

When signals are originally generated, most are relatively noise-free. The bulk of the noise present on a received signal has been added to the signal during its transmission. Isolation and segregation of signal sources and wiring from noise sources is highly effective as a recovery means. This technique, as well as the low-pass filtering previously mentioned, serves to reduce the recovery problem to one of amplitude or energy level discrimination.

2.3 NOISE SOURCES

The following devices and circuits are common sources of noise:

- Inductive devices, such as relays and solenoids.
- AC and DC power circuits, and wiring.
- Switchgear.
- Fast-rise-time sources: thyristors and certain solid-state switching circuits.
- Variable-frequency or variable current devices.

2.4 NOISE CLASSES

Signal and power circuits, wiring, and cables are classified as high-level or low-level sources of noise and interference. A definition of each class of noise is given in the following figure.

Noise Class Definitions

NOISE CLASS	LEVEL	DEFINITION
H	High	Includes AC/DC signals: a. 110VAC, 115VAC under 15A except brakes and fields. b. Up to 100A, 500VDC or 440VAC including brakes and fields. c. Over 100A, 500VDC, 440VAC. d. 2.3kV and over.
M	Medium	Includes digital I/O signals greater than 48V.
L	Low	Includes 24/48V digital I/O signals, and contact input.
Q	Very Low	Includes analog I/O signals as well as digital pulse inputs to high-speed counting circuits and data links.

(See *Planning and Installing Your Ovation System*.)

2.5 NOISE REJECTION

2.5.1 WHAT TYPES OF DIGITAL SIGNAL NOISE REJECTION ARE USED?

The Ovation System employs three specific noise rejection measures for digital signal plant interconnections:

- Low pass filtering.
- Substantial signal levels (48 VDC or 115 VAC).
- Isolation or optical coupling.

Low pass filtering and the use of large signal level techniques provide frequency and energy level discrimination, respectively.

Isolation of the digital signal receiver from ground is important as a means for rejecting noise which causes both wires in a signal pair to change voltage-to-ground potentials. An example of this type of isolation is a signal source (transmitter) which is grounded at a point remote from the receiver, where transmitter and receiver grounds are not at the same voltage. In this case, ground potential difference appears as a voltage on both wires of the corresponding signal pair.

Another example in which isolation may be required to reject ground potential difference noise would be in circuits where coupling exists between signal wires, inducing a potential in both wires. Induced potentials can occur when signal wires are present in environments with changing electromagnetic or electrostatic fields. Isolation may be required in this case.

An optical isolator (also known as an opto-isolator) may be used to bring digital signals into the receiver. No receiver response to noise can occur unless signal line noise current flows. Low frequency current, which may flow as a result of equal noise voltage-to-ground potentials on both wires of the signal pair, is eliminated if the signal wires are not grounded at more than one point. This is called the **common-mode voltage**.

Note: *High frequency noise currents can flow using stray capacitance as part of their path. This requires the use of low pass filtering in addition to the optical isolation.*

Analog Signal Noise Rejection

Analog signal isolation is provided for the same reasons that are discussed for digital signals (see page 9). However, since analog signals are typically low level, filtering and isolation noise rejection techniques are more critical for analog signals than for digital signals.

Analog signal filtering is achieved by averaging applied signals for one cycle (or an integer multiple of cycles) of the AC power line frequency. Power line related noise, at the power line frequency and its harmonics, has exactly zero average value when the average is taken over exactly one cycle and is filtered out of the signal by this technique.

Transient noise (high frequency damped ringing) has zero average value for averages taken over time periods much longer than the duration of the transients.

Output Signal Noise Rejection

Digital output signals from the Ovation System to the plant are electromechanical or semiconductor outputs which are electrically isolated from the Controller. Analog output signals from the Ovation system to the plant are either voltage or current outputs which are also electrically isolated from the Controller.

Noise-Sensitive Circuit Noise Rejection

All transmitting, low-level analog and digital circuits must be assumed to be noise-sensitive and to require special protection against noise. Field signals from process transducers (thermocouples, RTDs, and so forth) are especially susceptible to noise. Noise can be coupled into these sensitive circuits in three ways:

- Electrostatic coupling via distributed capacitances.
- Electromagnetic coupling via distributed inductances.
- Conductive coupling, such as circuits sharing a common return.

Noise suppression for these noise sensitive circuits involves one or more of the following basic measures:

- Physical separation (see page 10) between noise-producing and noise-sensitive circuits.
- Twisted-pair wiring (see page 10) for signal connection within plant.
- Proper grounding (see page 11), especially avoiding multiple grounding of cable shields and proper shielding, especially cable shielding.
- Surge protection (see page 11) to IEEE and ANSI standards.

PHYSICAL CIRCUIT SEPARATION

Circuit separation is a simple and effective means of electrostatic and electromagnetic field induced noise control. This is because electrostatic and electromagnetic fields decay with increasing distance, producing lower amplitude noise and maintaining a good signal-to-noise ratio.

TWISTED-PAIR WIRING

Twisted-pair wiring suppresses noise by acting to eliminate circuit loops which are sensitive to stray electromagnetic fields. For this reason, it is recommended that all analog signal circuit connections should be made with twisted-pair wire. Digital signal connections should carry a group return (or common) wired in the same cable as the signal wires.

Twisted pairs are also recommended in digital circuits where unusually noisy environments exist. Twisting of the signal wire and its return conductor becomes increasingly important as the length of the two becomes greater, and as the distance from noise sources becomes less. In twisted pairs or small cables (less than 1/2 inch outer conductor circle diameter), a twist rate of at least one to two twists per foot is recommended.

PROPER GROUNDING AND SHIELDING

Proper grounding, along with shielding, causes noise-induced currents to flow in the shield, and from the shield to ground, rather than in the corresponding signal conductors. Shielding itself is useful in avoiding capacitively coupled noise. The shield's sole function is to decrease effective capacitance from conductors inside the shield to conductors outside. To accomplish this, the shield should be as continuous as possible and equipped with a "drain wire" for secure single-point grounding.

Conductors and corresponding returns may be grouped within a shield only if capacitive coupling between them is acceptable. Avoid the grouping of low-level and high-level analog inputs, contact inputs, and contact outputs within a single shield. Shields are used as current-carrying conductors on some systems. To be effective, shields are grounded at the same point as the signals within, except as otherwise noted within this document.

SURGE PROTECTION

Surge protection to IEEE C37.90.1 -1989 (Reference ANSI C37.90.1-1989) standards is provided on most Ovation I/O modules. Check individual module descriptions for availability or possible additional conditions.

Ovation I/O modules, designated as being CE Mark compliant, have surge protection as follows when installed in CE Mark certified cabinets:

Surge Protection Levels

SPECIFICATION	LEVEL
EN 61000-4-3 (Radiated Field Immunity)	10 V/m
EN 61000-4-4 (Electrical Fast Transient Immunity)	1 Kv
EN 61000-4-5 (Surge Immunity)	1 Kv
EN 61000-4-6 (Conducted Radio Frequency Immunity)	*10 V rms
*The HART Analog Input and HART Analog Output modules meet a reduced level of 3V rms.	

2.6 ANALOG SIGNAL SHIELDING TECHNIQUES

For noise suppression purposes, analog signals of less than one volt is considered low-level and (as is the case with all analog signals), require shielding. Individually twisted and shielded pairs should be used for all analog input signal wiring. Multi-pair cable can be used if each twisted pair in the cable has its own insulated shield. Use the following guidelines to shield signals:

- Ground the analog signal shield.
- Ground the shield at one end only, preferably to a single point at the signal source, except as otherwise noted in this document.
- Connect the low side of the signal to the shield at the signal source. If the shield cannot be conveniently grounded at or near the signal source, ground it at the Controller. An ideal analog signal field connection is shown in the following figure
- Run the shield (unbroken) from the transducer to the shield terminal of the Analog to Digital (A/D) front-end at the Analog Input module. (See *Planning and Installing Your Ovation System.)* Maintain shield continuity at junction boxes when they are used.

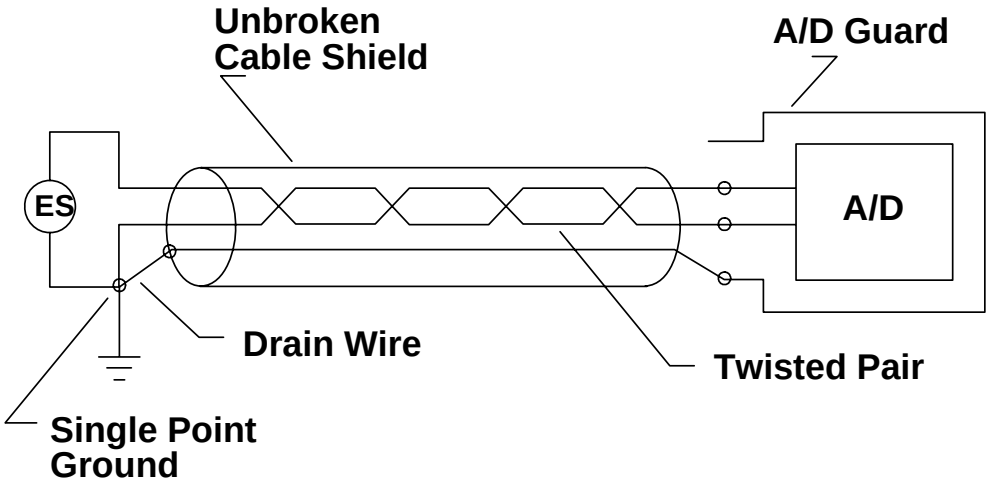
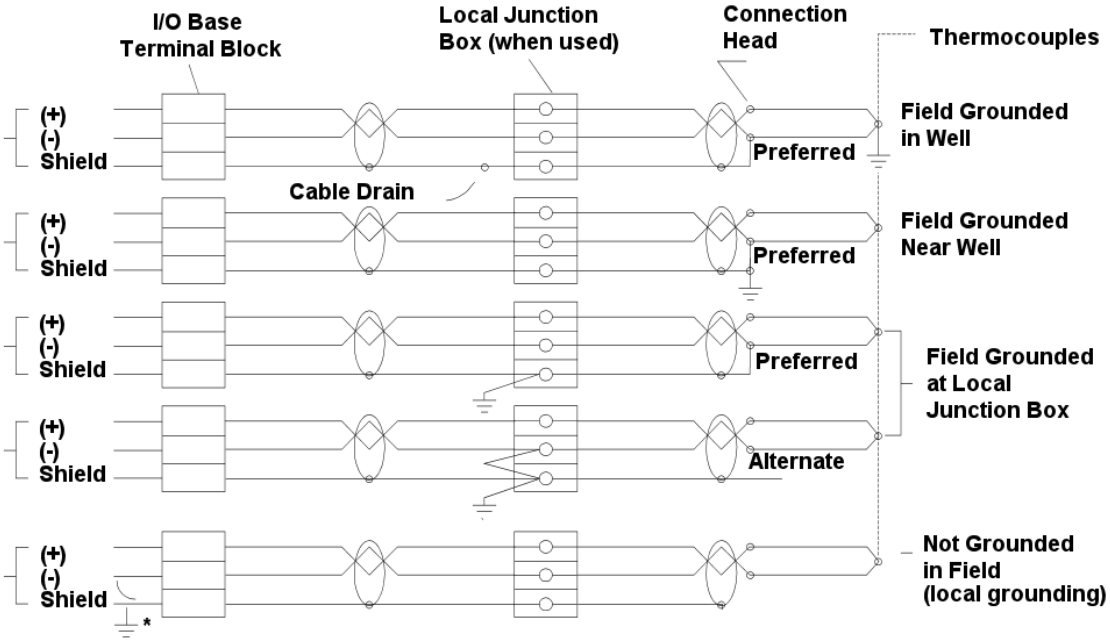


Figure 3: Ideal Analog Signal Field Connection

The following figure shows the typical recommended thermocouple analog signal wiring and the next figure shows the recommended sensor analog signal wiring.

Note: *See Personality Module Jumpers (see page 33) for details on how to access the jumpers.*



*** Grounding is set through jumpers within the Personality module. The default setting for the module has the jumpers installed for local grounding. To configure for field grounding, the jumpers must be removed.**

Figure 4: Typical Thermocouple Analog Signal Wiring by User

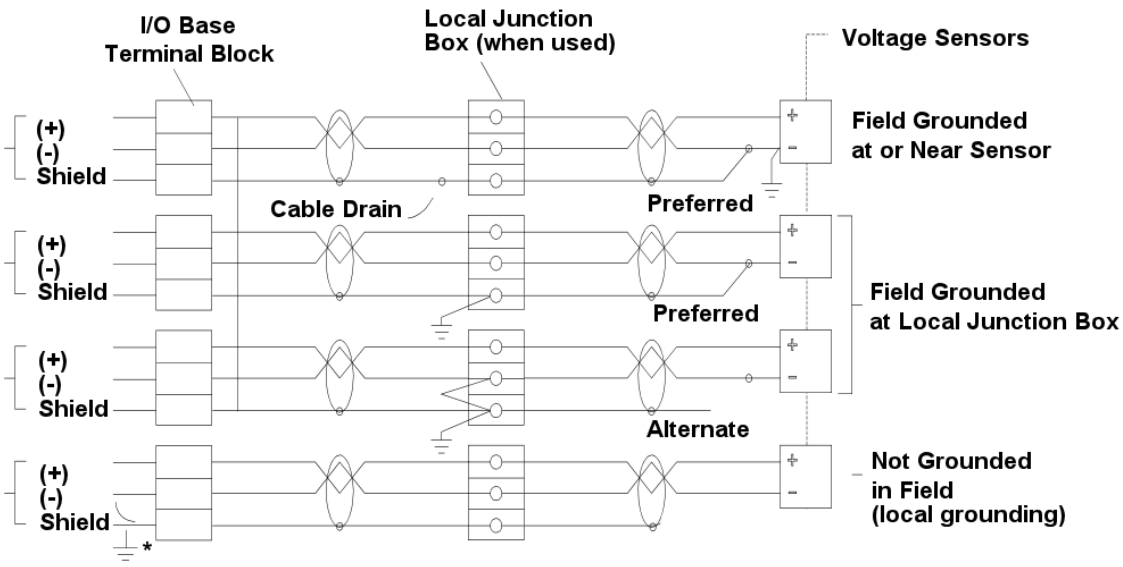

I/O Base
Terminal Block
Local Junction
Box (when used)
Voltage Sensors
(+)
(-)
Shield
Cable Drain
Preferred
Field Grounded
at or Near Sensor
Preferred
Field Grounded
at Local Junction Box
Alternate
Not Grounded
in Field
(local grounding)
*
* Grounding is set through jumpers within the Personality module (for AI-13 bit), or at the termina block of the module (for AI-14 bit). The default setting for the module (AI-13 bit) has the jumpers installed for local grounding. To configure for field grounding, the jumpers must be removed. The AI-14 bit module requires a jumper wire to be installed at the terminal block for local grounding. See individual module sections for details.

Figure 5: Typical Sensor Analog Signal Wiring by User

2.7 WHAT ARE SOME COMMON INPUT CONSIDERATIONS?

2.7.1 4 TO 20 MA SIGNAL CONSIDERATIONS

When sufficient separation from noise sources exists, this standard class of control signal does not require shielded cables. However, it is strongly recommended for surge protection. Use of twisted-pair cables is recommended.

Digital Signal Considerations

The Ovation System's digital I/O circuits used in data transmission do not require individual twisted or shielded pair conductors. A multi-conductor cable, in which one conductor serves as a common return and with a single overall cable shield, is sufficient for most Ovation digital signal applications.

Contact Closure Signal Considerations

- Outputs (CCO) - These circuits usually require no shielding.
- Inputs (CCI) - These circuits require no shielding if the net current in the cable is zero.

CE Mark Considerations

For CE Mark certified systems, all field wiring must be braid-shielded and grounded at the entry point of the cabinet using the recommended hardware. (See *Planning and Installing Your Ovation System*.)

SECTION 3

I/O MODULE GENERAL INFORMATION

IN THIS SECTION

What General Information Should I Know About Ovation I/O Modules? *15*
What are the I/O Module Types? *22*
Ovation Module Choices *25*
Installing Ovation Modules *29*
Ovation Module Configuration and Status *30*
Ovation Module Diagnostic LEDs *30*
What is Involved in the Replacement of User Serviceable Fuses? *31*
Personality Module Jumpers *33*
I/O Environmental Specifications *34*

3.1 WHAT GENERAL INFORMATION SHOULD I KNOW ABOUT OVATION I/O MODULES?

The following information gives an over-all view of the standard Ovation Electronic and Personality Modules including:

- Features (see page 16)
- I/O Module types (see page 22)
- Module choices (see page 25) (which personality modules go with which electronic modules)
- Installation (see page 29)
- Configuration (see page 30)
- Diagnostics LEDs (see page 30)
- User Serviceable Fuses (see page 31)
- Personality Module Jumpers (see page 33)
- I/O environmental specifications (see page 34)

3.1.1 OVATION MODULE FEATURES

- Ovation I/O is available in both remote and local configurations.
- Modular, “plug-in” components.
- Quick installation and configuration of the modules.
- DIN Rail mounting of the I/O Base Units.
- Wiring schematic labels are provided on Personality modules and foam inserts.
- Wiring directions (**N**ormally **C**losed, **N**ormally **O**pen, **C**ommon) are provided on the Base Unit for Relay Output modules.
- Writable surface labels are provided on Electronics modules so that up to 16 point names can be identified on each label.
- The labels on the Personality and Electronics modules are color-coded to match the appropriate modules.
- Unique base unit interconnection scheme eliminates most power and communications wiring.
- Module style, group, serial number, and revision are stored electronically on each I/O module.
- “Hot swapping” capabilities streamline maintenance. (See *Planning and Installing Your Ovation System*.)
- Status indicators that display standardized diagnostic LED color codes.
- Up to 128 Local Ovation module units per Controller.
- Up to 1024 Remote Ovation module units per Controller.
- Base Unit common to all Standard I/O modules.
- Two Base Unit styles (G2R and KUEP) are available for Relay Output modules.
- Testpoint/probe holder on each field terminal of standard I/O Base Units.
- Built-in spare fuse holders and wire strip gauge in standard I/O Base Units.
- Most modules are CE Mark compliant.

Standard Module Components

The standard Ovation module consists of three parts (refer to the following figure):

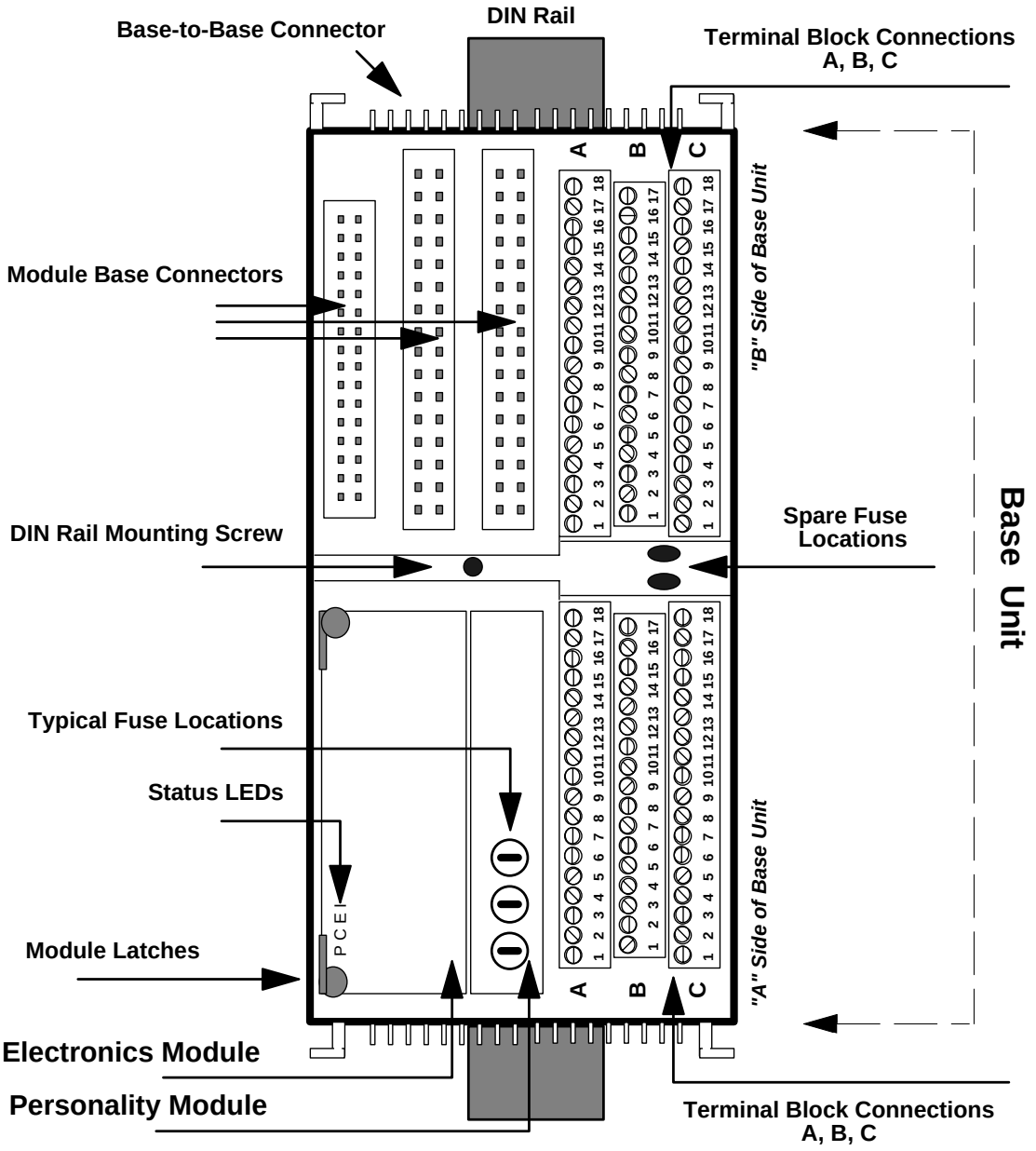


Figure 6: Ovation Modules (Top View)

1. **Base Unit**

   The base unit (containing two terminal blocks) mounts onto a DIN rail. Each base unit accommodates two I/O modules.

   The footprint of the base unit (containing Electronic and Personality module) is:
   27.9 cm Long (11 in)
   12.7 cm Wide (5 in)
   16.5 cm High (6.5 in)

If you use only one I/O module, you still must use a base unit that contains two terminal blocks.

CAUTION! *for CE Mark Certified Systems:*

Base units containing differential digital input modules configuration with hazardous input voltages (>30 V RMS, 42.4 V peak, or 60 VDC) listed in the following table must include a hazardous voltage warning label (1B30025H01) on that base unit. Hazardous voltage is present on the individual module terminal blocks and module connector(s).

Differential digital input module configurations with hazardous input voltages

CONFIGURATION	EMOD	PMOD
125VAC/VDC Digital Input (Diff)	1C31107G02	1C31110G02
125VAC/VDC Compact Digital Input (Diff)	1C31232G03	1C31238H01
125VDC Sequence of Events (Diff)	1C31157G02	1C31110G02
125VDC Compact Sequence of Events (Diff)	1C31233G03	1C31238H01

CAUTION! Base units containing single ended or fused digital input modules with hazardous voltages (>30 V RMS, 42.4 V peak, or 60 VDC) listed in the following table must include a hazardous voltage warning label (1B30025H01) on the base unit as well as ALL base units of the branch. Hazardous voltage is present on terminal block and module connectors of bases on an entire branch. In addition, auxiliary power fuses must be removed and a fuse cover kit should be added (see page 539).

Base units containing single ended or fused digital input modules with hazardous voltages

CONFIGURATION	EMOD	PMOD
125VAC/VDC Digital Input (Sing)	1C31107G02	1C31110G01
125VAC/VDC Compact Digital Input (Fused)	1C31232G03	5X00034G01
125VDC Sequence of Events (Sing)	1C31157G02	1C31110G01
125VDC Compact Sequence of Events (Fused)	1C31233G03	5X00034G01

CAUTION! Hazardous labels must be placed in a visible location on the base unit, preferable above the spare fuse location. This information must be indicated in the application specific project drawings.

2. **Electronics module** (Emod)

   The Electronics module (configured by adding the appropriate Personality module) fits into the base unit.

3. **Personality module** (Pmod)

   The Personality module (configures the Electronics module) fits into the base unit beside the appropriate Electronics module.

Note: *The Personality module is installed in the base unit* ***first****. Then, the Electronics module is installed and interlocks with the Personality module. The blue corner latches on the Electronics module locks both modules into the base unit.*

Wires from customer field devices are connected to terminal block in the base unit.

The wiring connections to the terminal block for each combination of Electronics module and Personality module are printed on each Personality module, and are illustrated in each module description in the following sections.

Relay Module Components

The Ovation Relay module consists of two parts (refer to the following figures):

1. Base Unit

   The relay base assembly consists of a backplane with connectors, a plastic housing, and a DIN rail clamping/grounding mechanism. This unit accommodates the relays for interfacing with field devices.

2. Relay Output Electronics Module

   The relay output electronics module is an on-line replaceable module that provides the relay output circuit board. This board contains relay coil drive interfacing as well as I/O bus and bus power interface. This module plugs into the desired relay output base unit.

The wires from the customer field devices are connected to the terminal block in the base unit.

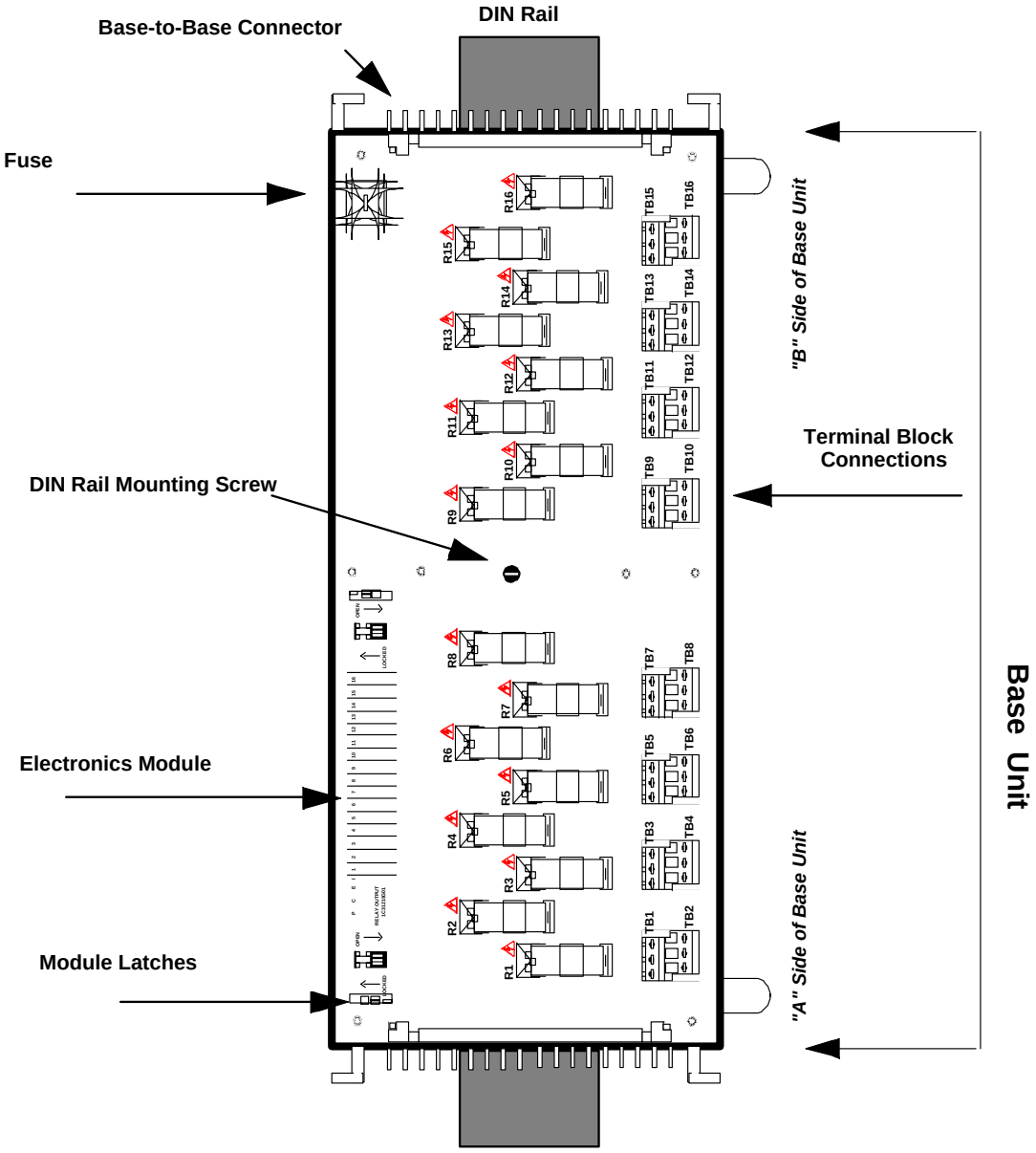


Figure 7: Relay Output Panel G2R

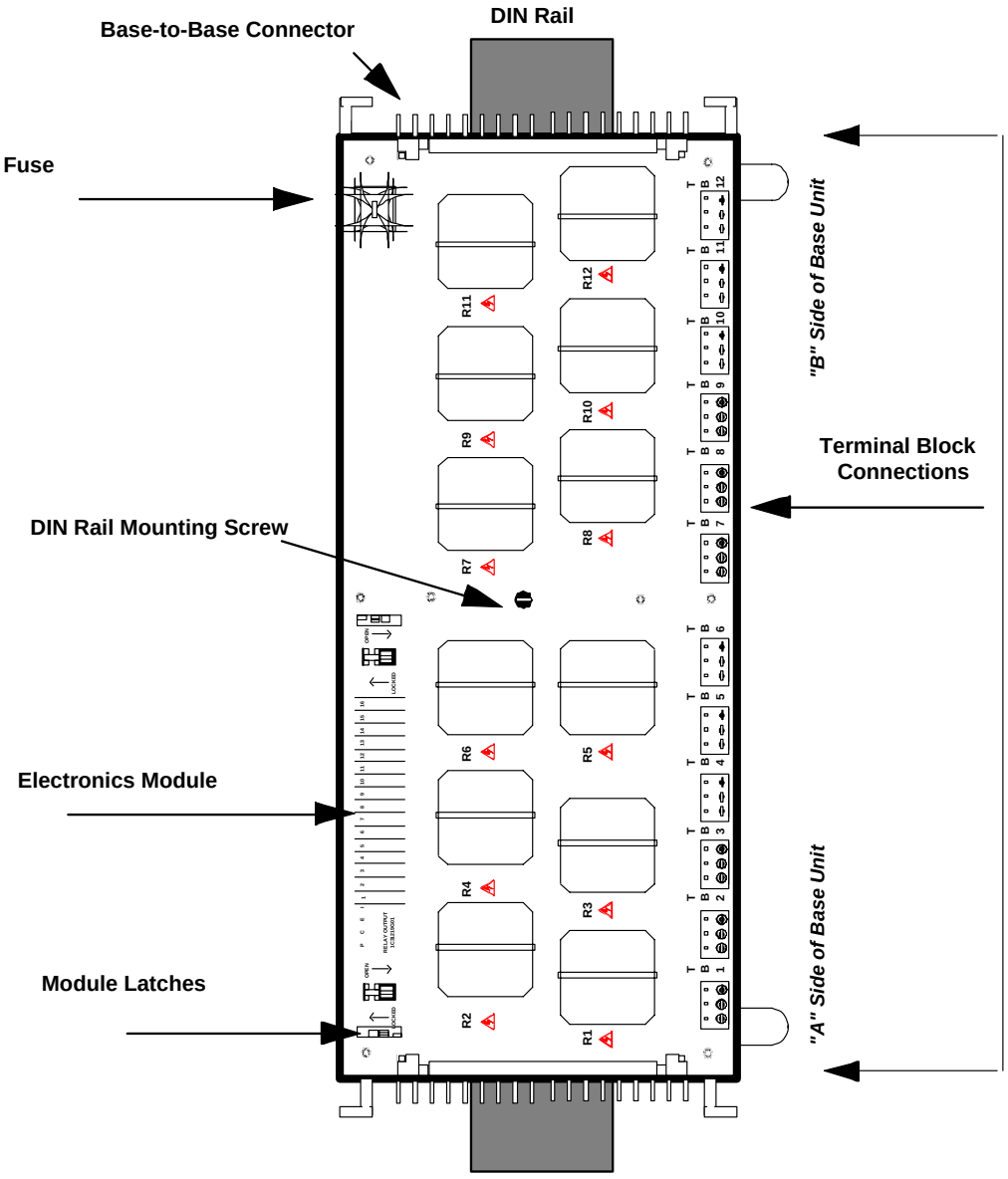


Figure 8: Relay Output KUEP

3.2 WHAT ARE THE I/O MODULE TYPES?

The following topics list the types of I/O modules and provide a brief description of each type:

Analog Input Modules (see page 23)

- Analog Input (13 bits) (Legacy product)
- Analog Input (14 bits)
- Analog High Speed Input (14 bits)
- HART Analog Input
- HART High Performance Analog Input
- RTD (4-Inputs)
- RTD (8-Inputs)

Analog Output Modules (see page 23)

- Analog Output
- HART Analog Output
- HART High Performance Analog Output

Digital Input Modules (see page 24)

- Digital Input
- Compact Digital Input
- Contact Input
- Compact Contact Input
- Sequence of Events Input
- Compact Sequence of Events Input

Digital Output Modules (see page 24)

- Digital Output
- Relay Output

Specialty Modules (see page 25)

- Link Controller
- Loop Interface
- Pulse Accumulator
- Servo Driver
- Speed Detector
- Valve Positioner
- SLIM (Small Loop Interface Module)

3.2.1 ANALOG INPUT MODULES

Analog Input (13 bits) **(see page 37) -** (Legacy product) - provides interface to eight individually isolated analog inputs with sampling rates of approximately 10 time/sec. Several voltage and current configurations are available including cold junction compensation for thermocouple inputs.

Analog Input (14 bits) (see page 55) - provides an interface to eight individually isolated analog inputs with a minimum sampling rate of 10 time/sec. A low cost 4-20 mA current input is available along with a 1V voltage input (legacy) configuration.

Analog High Speed Input (14 bits) (see page 67) - provides an interface to eight individually isolated analog inputs with sampling rates of medium speed (16/20 time/sec.) or high speed (50/60 times/sec.). Several voltage and current input configurations are available including cold junction compensation for thermocouple inputs.

HART Analog Input (see page 177) - provides an interface for eight HART field devices with 4-20 mA current loop analog inputs (common reference). In addition to the analog inputs, digital information can be exchanged between HART compliant devices and the Controller.

HART High Performance Analog Input (see page 193) - provides an interface for eight HART field devices with 4-20 mA current loop analog inputs (common reference). In addition to the analog inputs, digital information can be exchanged between HART compliant devices and the Controller.

RTD 4-Input (see page 305) - provides an interface to four Resistance Temperature Detectors. Several 3 and 4 wire RTD types are supported. A 50/60 Hz filtered configuration is available for CE Mark applications.

RTD 8-Input (see page 317) - provides interface to eight Resistance Temperature Detectors. Several 3 and 4 wire RTD types are supported.

3.2.2 ANALOG OUTPUT MODULES

Analog Output (see page 93) **-** provides an interface to four individually isolated analog outputs using 12 bit digital-to-analog converters.

HART Analog Output (see page 207) - provides an interface for eight HART field devices with 4-20 mA current loop analog outputs (common reference). In addition to the outputs, digital information can be exchanged between HART compliant devices and the Controller.

HART High Performance Analog Output (see page 223) - provides an interface for eight HART field devices with 4-20 mA current loop analog outputs (common reference). In addition to the outputs, digital information can be exchanged between HART compliant devices and the Controller.

3.2.3 DIGITAL INPUT MODULES

Digital Input (see page 125) - provides an interface for 16 digital inputs. The following input configurations are available: 24V, 48V, and 125V Isolated Differential or Single Ended (common return).

Compact Digital Input (see page 137) - provides a low cost interface for 16 digital inputs by eliminating the need for a Pmod. The following input configurations are available: 24V or 48V Isolated Differential or Single Ended (common return), or 125V isolated differential. If desired, a Pmod can be added to individually fuse inputs (with common return).

Contact Input (see page 101) - provides an interface for 16 digital contact inputs with common return. A +48V on-board power supply provides current limited contact wetting.

Compact Contact Input (see page 113) - provides a low cost interface for 16 digital contact inputs with common return by eliminating the need for a Pmod. A +48V on-board power supply provides current limited contact wetting.

Sequence of Events Input (see page 329) - provides an interface for 16 digital inputs with time tagging information to within 125 ms. An event tagging mask and filters to reject state changes and input chatter are provided along with time synchronization to the Controller with 1 ms resolution. Several input configurations are available.

Compact Sequence of Events Input (see page 351) - provides a low cost interface for 16 digital inputs with time tagging information to within 125 ms. An event tagging mask and filters to reject state changes and input chatter is provided along with time synchronization to the Controller with 1 ms resolution. Several input configurations are available. If desired, a Pmod can be added to individually fuse the inputs (with common return).

3.2.4 DIGITAL OUTPUT MODULES

Digital Output (see page 151) - provides an interface to 16 single ended digital outputs. 5 to 60 VDC loads up to 500 mA each can be controlled (Total current limited by fuse rating.) This module can also be used to interface KU, G2R or solid state relay panels for increased switching capability.

Relay Output (see page 291) - provides an interface to either 12 KU relay or 16 G2R relay outputs. Special relay bases connect directly to the Ovation I/O branches and house the Relay Output Electronics module and relays.

3.2.5 SPECIALTY MODULES

Link Controller (see page 235) - provides a serial RS232, RS422, or RS485 data communications link to a third party device or system.

Loop Interface (see page 237) - provides an interface to the analog and digital I/O needed to control a single process loop (up to 2 AI, 1 AO, 2 DI, 2 DO). In addition, the loop interface can display the process information and provide for manual control via a local operator interface station (SLIM).

Pulse Accumulator (see page 269) - counts pulse for up to two input channels and provides the information to the Controller. The Pulse accumulator may be used to count over a defined time period to measure speed (frequency), count until instructed to stop, or can be used to measure the duration of a pulse.

Servo Driver (see page 373) - provides an interface to an electro-hydraulic servo actuator (servo-motor) used to control a steam turbine.

Speed Detector (see page 415) - provides the Controller with frequency measurements of a sinusoidal or pulse train tachometer. A 16-bit output can be updated at a rate of 5 ms for over-speed detection, and a 32-bit output can be updated at a variable rate for speed regulation.

Valve Positioner (see page 425) - provides an interface to an electro-hydraulic servo actuator. Governor valves, interceptor valves, extraction valves and bypass valves can be controlled. The module provides closed loop valve positioning control and also interfaces to a local operator interface station (SLIM).

SLIM (Small Loop Interface Module) (see page 415) - contains displays and keyboard inputs needed for an operator to monitor and control the I/O functions of the Ovation Loop Interface or Valve Positioner module. The SLIM is located external to the Ovation I/O cabinet and connected to the Loop Interface or Valve Positioner via cable.

3.3 OVATION MODULE CHOICES

The following table shows all of the Module types and their viable combinations of Emod and Pmod.

Ovation Module Choices

MODULE TYPE	CHANNEL	ELECTRONIC MODULE	PERSONALITY MODULE
Analog Input (± 100mV) (13 bit) [1]	8	1C31113G03	1C31116G01
Analog Input (± 100 mV w/temp. sensor) (13 bit) [1]	8 [2]	1C31113G03	1C31116G04
Analog Input (± 20mV) (13 bit) [1]	8	1C31113G01	1C31116G01
Analog Input (± 20mV w/temp. sensor) (13 bit) [1]	8 [2]	1C31113G01	1C31116G04
Analog Input (± 50mV) (13 bit) [1]	8	1C31113G02	1C31116G01
Analog Input (± 50mV w/temp. sensor) (13 bit) [1]	8 [2]	1C31113G02	1C31116G04
Analog Input (± 1 VDC) (13 bit) [1]	8	1C31113G04	1C31116G01

MODULE TYPE	CHANNEL	ELECTRONIC MODULE	PERSONALITY MODULE
Analog Input (± 10 VDC) (13 bit) [1]	8	1C31113G06	1C31116G01
Analog Input (± 5 VDC) (13 bit) [1]	8	1C31113G05	1C31116G01
Analog Input (0-20 or 4-20 mA Local PS) (13 bit) [1]	8	1C31113G05	1C31116G03
Analog Input (0-20 or 4-20 mA Remote PS) (13 bit) [1]	8	1C31113G05	1C31116G02
Analog Input (4-20 mA) (14 bit Low Speed)	8	1C31224G01	1C31227G01
Analog Input (± 1 VDC) (14 bit Low Speed) [1]	8	1C31224G02	1C31227G02
Analog Input (4-20 mA) (14 bit High Speed (HS))	8	5X00070G01	1C31227G01
Analog Input (± 100mV, ± 250mV, ± 1V) (14 bit HS)	8	5X00070G02	1C31227G02
Analog Input (± 5V, ± 10V) (14 bit HS)	8	5X00070G03	1C31227G02
Analog Input (± 1mA, (using 250mV) 2 wire Local PS) (14 bit HS) (Turbine)	8	5X00070G02	1C31116G03
Analog Input (± 1mA, (using 250mV) 4wire field powered) (14 bit HS) (Turbine)	8	5X00070G02	1C31116G02
Analog Input (± 20mV, ± 50mV, ± 100mV) (Thermocouple) (14 bit MS)	8	5X00070G04	1C31116G04
Analog Output (0 to +10 V)	4	1C31129G02	1C31132G01
Analog Output (0 to +5 V)	4	1C31129G01	1C31132G01
Analog Output (0-20 or 4-20 mA w/diagnostics)	4	1C31129G03	1C31132G01
Analog Output (0-20 or 4-20 mA w/o diagnostics)	4	1C31129G04	1C31132G01
Contact Input w/Onboard 48 V wetting (Compact)	16	1C31234G01	Cavity Insert [3]
Contact Input w/Onboard 48 V wetting [1]	16	1C31142G01	1C31110G03
Digital Input (125 VAC/VDC differential) [1]	16	1C31107G02	1C31110G02
Digital Input (125 VAC/VDC single ended)	16	1C31107G02	1C31110G01
Digital Input (24 VAC/VDC or 48 VDC differential) [1]	16	1C31107G01	1C31110G02
Digital Input (24 VAC/VDC or 48 VDC single ended) [1]	16	1C31107G01	1C31110G01
Digital Input (125 VAC/VDC Indiv. Fused) (Compact)	16	1C31232G03	5X00034G01
Digital Input (125 VAC/VDC differential) (Compact)	16	1C31232G03	Cavity Insert [3]
Digital Input (24/48 VAC/VDC Indiv. Fused) (Compact)	16	1C31232G02	5X00034G01
Digital Input (24 or 48 VAC/VDC differential) (Compact)	16	1C31232G02	Cavity Insert [3]
Digital Input (24 or 48 VDC single ended) (Compact)	16	1C31232G01	Cavity Insert [3]
Digital Output (5-60 VDC) Single ended direct	16	1C31122G01	1C31125G01
Digital Output (relay pnl comm, Local PS)	16	1C31122G01	1C31125G02

MODULE TYPE	CHANNEL	ELECTRONIC MODULE	PERSONALITY MODULE
Digital Output (relay pnl comm Remote PS)	16	1C31122G01	1C31125G03
HART Analog Input 16 Bit (4 - 20 mA)	8	5X00058G01	5X00059G01
HART Analog Output14 Bit (4 - 20 mA)	8	5X00062G01	5X00063G01
HART High Performance Analog Input (4 - 20 mA) Local or Remote PS.	8	5X00106G01	5X00109G01
Link Controller RS232	-	1C31166G01	1C31169G01
Link Controller RS485/422 Four Wire	-	1C31166G01	1C31169G02
Loop Interface (AI: 0-10V AO: 0-10V)	2-4 analog 4 digital	1C31174G01	1C31177G01
Loop Interface (AI: 0-10V AO: 0-10V) User defined Digital Inputs [4]	2-4 analog 4 digital	1C31174G21	1C31177G01
Loop Interface (AI: 0-5V AO: 0-10V)	2-4 analog 4 digital	1C31174G02	1C31177G01
Loop Interface (AI: 0 - 5V AO: 0 - 10V) User defined Digital Inputs [4]	2-4 analog 4 digital	1C31174G22	1C31177G01
Loop Interface (AI: 4 - 20mA AO: 4 - 20mA Remote PS)	2-4 analog 4 digital	1C31174G03	1C31177G03
Loop Interface (AI: 4 - 20mA AO: 4 - 20mA Remote PS) User defined Digital Input [4]	2-4 analog 4 digital	1C31174G23	1C31177G03
Loop Interface (AI: 4 - 20mA AO: 4 - 20mA Local PS)	2-4 analog 4 digital	1C31174G03	1C31177G02
Loop Interface (AI: 4 - 20mA AO: 4 - 20mA Local PS) User defined Digital Input [4]	2-4 analog 4 digital	1C31174G23	1C31177G02
Loop Interface (AI: 4 - 20mA Remote PS) Electric Beck Drive	2-4 analog 2 digital	1C31174G04	1C31177G03
Loop Interface (AI: 4 - 20mA Remote PS) User defined Digital Input [4] Electric Beck Drive	2-4 analog 4 digital	1C31174G24	1C31177G03
Loop Interface (AI: 4 - 20mA Local PS) Electric Beck Drive	2-4 analog 2 digital	1C31174G04	1C31177G02
Loop Interface (AI: 4 - 20mA Local PS) User defined Digital Input [4] Electric Beck Drive	2-4 analog 4 digital	1C31174G24	1C31177G02
Pulse Accumulator (24/48V or 5/12V med speed Remote PS, pos/neg com)	2	1C31147G01	1C31150G03
Pulse Accumulator (24/48V or 5/12V med speed Local PS, neg com)	2	1C31147G01	1C31150G01

MODULE TYPE	CHANNEL	ELECTRONIC MODULE	PERSONALITY MODULE
Pulse Accumulator (24/48V or 5/12V med speed Local PS, pos com)	2	1C31147G01	1C31150G02
Pulse Accumulator (5V high speed Remote PS)	2	1C31147G02	1C31150G03
Pulse Accumulator (5V high speed, Local PS neg com)	2	1C31147G02	1C31150G01
Pulse Accumulator (5V high speed, Local PS pos com)	2	1C31147G02	1C31150G02
Relay Output Module G2R	16	1C31219G01	1C31223G01 (Base Unit)
Relay Output Module KUEP (Form C or X)	12	1C31219G01	1C31222G01 (Base Unit)
RTD Interface (4 channel) [1]	4	1C31161G01	1C31164G01
RTD Interface (4 channel) (50-60 Hz filtered)	4	1C31161G02	1C31164G02
RTD Interface (8 channel)	8	5X00119G01	5X00121G01
Seq. of Events (125VDC differential) [1]	16	1C31157G02	1C31110G02
Seq. of Events (125VDC single ended)	16	1C31157G02	1C31110G01
Seq. of Events (24/48VDC differential) [1]	16	1C31157G01	1C31110G02
Seq. of Events (24/48VDC single ended) [1]	16	1C31157G01	1C31110G01
Seq. of Events contact input w/48V wetting [1]	16	1C31157G03	1C31110G03
Seq. of Events (125VDC indiv. fused com rtn) (Compact)	16	1C31233G03	5X00034G01
Seq. of Events (125VDC differential) (Compact)	16	1C31233G03	Cavity Insert [3]
Seq. of Events (24/48VDC indiv. fused com rtn) (Compact)	16	1C31233G02	5X00034G01
Seq. of Events (24VDC or 48VDC single ended) (Compact)	16	1C31233G01	Cavity Insert [3]
Seq. of Events (24/48VDC differential) (Compact)	16	1C31233G02	Cavity Insert [3]
Seq. of Events contact input w/48V wetting (Compact)	16	1C31233G04	Cavity Insert [3]
Servo Driver (19VAC 1KHz to an AC LVDT)	6	1C31199G02	1C31201G02
Servo Driver (19VAC 3KHz to an AC LVDT)	6	1C31199G03	1C31201G02
Servo Driver (±16VDC to a DC LVDT)	6	1C31199G01	1C31201G01
Speed Detector Interface	8	1C31189G01	1C31192G01
Valve Positioner (17 Volt 1Khz to an LVDT 82 Ohm Coil)	8	1C31194G01	1C31197G01
Valve Positioner (17 Volt 1Khz to an LVDT 250 Ohm Coil)	8	1C31194G01	1C31197G02
Valve Positioner (17 Volt 1Khz to an LVDT 1000 Ohm Coil)	8	1C31194G01	1C31197G03

MODULE TYPE	CHANNEL	ELECTRONIC MODULE	PERSONALITY MODULE
Valve Positioner (17 Volt 1Khz to an LVDT 125 Ohm Coil)	8	1C31194G01	1C31197G04
Valve Positioner (23.75 Volt 3Khz to an LVDT 82 Ohm Coil)	8	1C31194G02	1C31197G01
Valve Positioner (23.75 Volt 3Khz to an LVDT 250 Ohm Coil)	8	1C31194G02	1C31197G02
Valve Positioner (23.75 Volt 3Khz to an LVDT 1000 Ohm Coil)	8	1C31194G02	1C31197G03
Valve Positioner (23.75 Volt 3Khz to an LVDT 125 Ohm Coil)	8	1C31194G02	1C31197G04

[1] Used for legacy systems only.

[2] A ninth channel is provided when using the Analog Input module with temperature sensor. This ninth point is needed for the CJ Compensation field of the Point Builder Instrumentation tab when defining the eight other thermocouple points for the AI module (refer to Analog Input module sections) for additional information).

[3] Cavity insert (1C31238H01) that fits into the Personality module position providing a wiring schematic label for the module. Typically, there is no actual Personality module required for this module type.

[4] Raise and Lower Runback inputs can be disabled and used as user-defined input points. Configuration instructions are included in Kit 1C31174G20 - 1C31174G24.

3.4 INSTALLING OVATION MODULES

DIN rails and modules are typically installed at the factory according to system requirements. If you need to replace or add Relay Output modules to your system, see *Planning and Installing Your Ovation System*.

Standard and Compact I/O Modules

The Ovation standard and Compact modules are installed in base units mounted on DIN rails in Ovation cabinets. Each base unit can contain two I/O modules, and even if you only use one I/O module, you must still use a base unit that contains two terminal blocks.

Relay Output Modules

The Ovation Relay Output modules are installed in base units mounted on DIN rails in Ovation cabinets. Each base unit can contain one Relay Output Electronic module and the appropriate relays.

There are two styles of Relay Output Base Units (see page 19):

- 1C31223 (16 G2R relays)
- 1C31222 (12 KUEP relays)

3.5 OVATION MODULE CONFIGURATION AND STATUS

An Ovation I/O module has 16 address locations, but a module might not use all 16 addresses.

There are four possible address locations in each I/O module that are reserved for special use. Three of these addresses provide configuration (Write) and status (Read) information.

Definitions for these locations are provided for each module in the module reference pages:

- **Address word 13** (D in Hex) is present for every module and is used for configuration and status. The module status provides diagnostic information that is read by the Controller when it is on-line. The status register can be read by using the Point Information window at an Ovation Operator Station. The Bit Pattern Field can be read on the Hardware Tab of the Point Information window (See the *Ovation Operator Station User Guide*.)
- **Address word 14** (E in Hex) is used as a secondary or expansion configuration register and is only used when needed.
- **Address word 12** (C in Hex) is used for reporting point specific fault information and optionally as an expansion configuration register.
- **Address word 15** (F in Hex), is used for the module Electronic ID (see page 531) information. This location and its use are identical for all modules.

Configuration settings for these registers for a point can be viewed in the applicable Point Builder section of your system manuals. (See *Ovation Developer Studio User Guide* for the Windows system, and *Ovation Point Builder User Guide* or *Ovation I/O Builder User Guide* for the Solaris system.)

3.6 OVATION MODULE DIAGNOSTIC LEDS

Every Ovation module contains diagnostic LEDs. These are used to indicate the status of the module and to alert you to any module problems.

All I/O modules contain the following LEDs:

- **P** = (Green) Power OK LED is lit when the power supply to the module is good.
- **C** = (Green) Communications OK LED is lit when the Controller is communicating with the module, and when the communication watchdog timer is not timed out.
- **E** = (Red) Optional External Error LED is lit when there is a problem external to the module, such as a blown common auxiliary power supply fuse.
- **I** = (Red) Internal Fault LED is lit when a failure internal to the module has occurred. This LED is typically an indication that the Electronics module needs to be replaced.

Note: *A communication timeout also lights the Internal Fault LED and turns off the Communications OK LED.*

The other LEDs for each module vary according to the functions of the module. Definitions for LEDs are provided for each module in their individual sections.

3.7 What is Involved in the Replacement of User Serviceable Fuses?

Some Electronics modules (Emods) and Personality modules (Pmods) may contain fuses. These fuses are typically 5 x 20 mm micro-fuses, and are conveniently located (see page 17) for easy replacement.

3.7.1 Electronics Module Fuses

If a fuse needs to be replaced, push the fuse cap in, turn it one-quarter turn counter-clockwise, and the fuse pops up. Replace the blown fuse with an exact replacement fuse. Fuse sizes are indicated on the Electronics module label. Refer to the following table for descriptions of fuses used by Ovation Electronics modules.

Note: *In CE Mark Certified systems, the project drawings* ***MUST*** *include any fuses and their ratings, if they are replaceable by a qualified technician.*

Electronics Module Fuses

Type	Rating	Model	Part Number
5 x 20 mm cartridge	0.50A; 250V; Fast acting	Compact Digital Input Emod 1C31232G01 Compact Sequence of Events Emod 1C31233G01	EX06100

3.7.2 Personality Module Fuses

If a 5x20 mm cartridge fuse needs to be replaced, push the fuse cap in, turn it one-quarter turn counter-clockwise, and the fuse pops up. Replace the blown fuse with an exact replacement fuse. Fuse sizes are indicated on the Personality module label. Refer to the following table for descriptions of fuses used by Ovation Personality modules.

If the fuse is a micro fuse, pull the blown fuse out of its holder and plug the replacement fuse into the vacated holder.

Note: *In CE Mark Certified systems, the project drawings* ***MUST*** *include any fuses and their ratings, if they are replaceable by a qualified technician.*

Personality Module Fuses

Type	Rating	Model	Part Number
5 x 20 mm cartridge	0.50A; 250V; Fast acting	Digital Input Pmods Sequence of Events 1C31110G01	EX06100

TYPE	RATING	MODEL	PART NUMBER
5 x 20 mm cartridge	0.063A; 250V; Fast acting	Analog Input Pmods 1C31116G02 - G03 Loop Interface Pmods 1C31177G02 - G03	EX06102
5 x 20 mm cartridge	0.63A; 250V; Fast acting	Pulse Accum. Pmods 1C31150G01 - G03	EX06071
5 x 20 mm cartridge	1.0A; 250V Fast acting	Relay Base 16 G2R - 1C31223G01	EX06104
5 x 20 mm cartridge	1.25A; 250V; Fast acting	Loop Interface Pmods 1C31177G01 - G03 Digital Output Pmods - 1C31125G01 Valve Positioner Pmods 1C31197G01 - G04 Relay Panels (Solid State) 5A22410H01 - H02 Relay Panels (16 G2R) - 5A22411H01	EX06098
5 x 20 mm cartridge	2.0A; 250V; Fast acting	Relay Panels (8 KU) - 5A22412H01 Relay Base (12 KUEP) - 1C31222G01	EX06105
5 x 20 mm cartridge	3.15A;250V Fast acting	Digital Output Pmods - 1C31125G02	EX06101
Micro-Fuse Plug-in	0.5A;125V Fast acting	16 Point Individually fused, Digital Input Pmod - 5X00034G01 HART Analog Input Pmods 5X00063G01	1X00030H02
Micro-Fuse Plug-in	0.063A;125V Fast acting	HART Analog Input Pmods Analog Inputs - 5X00059G01	1X00030H01
Micro-Fuse Plug-in	0.6A;125V Fast acting	HART Analog Output Pmods 5X00063G01	1X00030H05

3.7.3 OVATION CABINET FUSES

In addition to Personality module fuses, there are other fuses that can also be serviced by users. Refer to the following table for descriptions of fuses used in Ovation cabinets.

Ovation Cabinet Fuses

TYPE	RATING	MODEL	PART NUMBER	NOTES
Micro-Fuse	5.0A; 250V; Fast acting	CBO Backplane 3A99200G01 - G02 ROP Panel 4D33922G01 TND Panel 4D33924G01 RRP Panel 3A99252G01 RRB Panel 3A99253G01	4A00120H01	Auxiliary power Branch fuses CBO: F1 -F4 ROP: F1, F2, F7, F8 TND: F1, F2, F6, F7 RRP: F1, F2 RRB: F1, F2
3 AB	15A; 250V; Fast acting	Power Distribution Panel 5A26304G02	EX06009	AC Main fuses F1, F2

3.8 PERSONALITY MODULE JUMPERS

Most of the Ovation Personality modules do not have configurable jumpers. However, if a module does have configurable jumpers, and the default settings need to be changed, the card must be removed from the Personality module case in order to be configured. Use the following procedure to open a Personality module case:

Note: *Be sure to observe static electricity guidelines.*

1. Use a small straight-edge screwdriver to press in one of the clips located on the side of the module until the module cap is loosened. Remove the module cap.
2. Push both clips on the module bottom outward until the card is free to slide.
3. Slide the card out the top of the module and make the desired jumper changes.
4. Slide the card back into the module case, being sure the card is positioned in the card channels, and the bottom clips are engaged.

5. Replace the module cap.

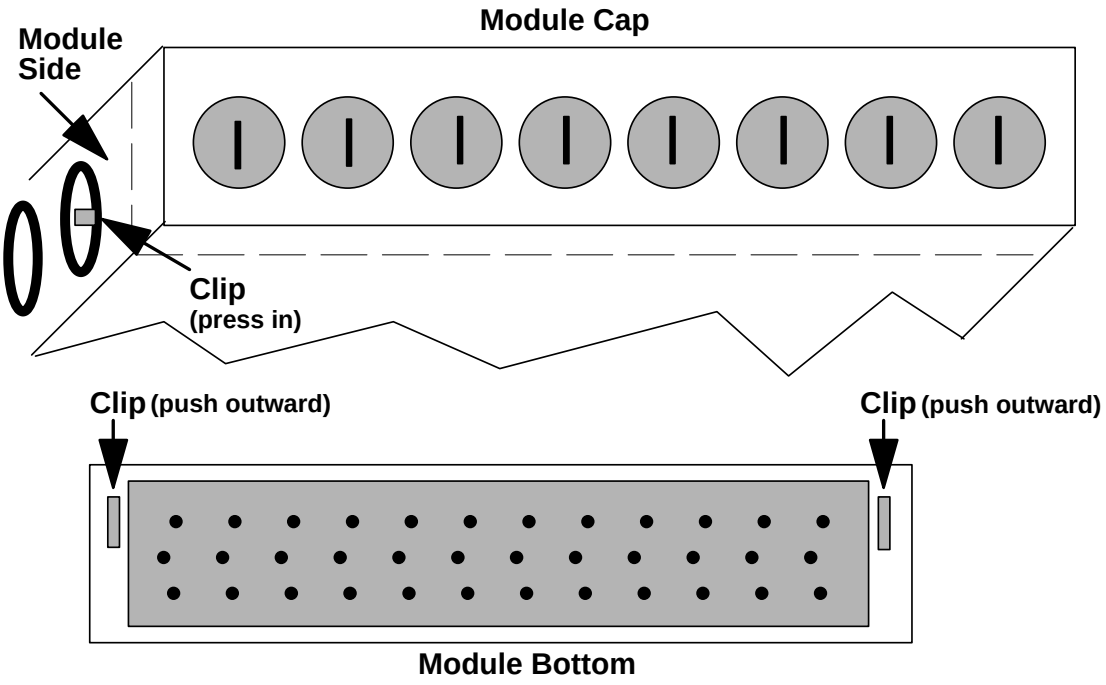


Figure 9: Module Cap

3.9 I/O Environmental Specifications

The following tables provide common environmental specifications for the Ovation I/O modules.

I/O Module Specifications

Description	Minimum Value	Maximum Value
Temperature	0oC (32o F) Operating - 40oC (-40oF) Storage	60oC (140oF) Operating 85oC (185oF) Storage
Humidity	0% Operating	95% Operating (Non-CE Mark) 90% Operating (CE Mark) Maximum wet bulb temp 35oC

Relay Output Module Specifications

Description	Minimum Value	Maximum Value
Temperature [1]		
Relay Output G2R/KUEP Form X	0oC (32oF) Operating - 40oC (-40oF) Storage	60oC (140oF) Operating 70oC (158oF) Storage
Relay Output KUEP Form C	0oC (32oF) Operating - 40oC (-40oF) Storage	45oC (113oF) Operating 50oC (122oF) Storage

DESCRIPTION	MINIMUM VALUE	MAXIMUM VALUE
Humidity		
Relay Output G2R	35% Operating	85% Operating (Non-CE Mark) Maximum wet bulb temp 35oC
Relay Output KUEP Form X/Form C	N/A	N/A
[1] See Relay Output Module (see page 291) for additional temperature and derating information relative to specific cabinet configuration.		

SECTION 4

ANALOG INPUT MODULE (13 BITS)

IN THIS SECTION

Description *37*
Module Group Information *37*
Module Specific Information *39*
Wiring Information *44*
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Diagnostic LEDs *52*
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4.1 DESCRIPTION

The Ovation Analog Input Module with associated Personality Module provides signal conditioning and analog-to-digital conversion for eight individually-isolated analog inputs. Field inputs are surge protected and routed by the appropriate Personality Module and then sent to the Electronics Module for conversion.

The Analog Input Module (13 bits) is applicable for CE Mark Certified Systems.

Note: *I/O Module General Information (see page 15) contains environmental, installation, wiring, and fuse information for I/O modules.*

4.2 MODULE GROUP INFORMATION

4.2.1 ELECTRONICS MODULES (EMODS)

There are six groups of Electronics modules for the Analog Input Module:

- **1C31113G01** provides voltage input range of ± 20 mV.
- **1C31113G02** provides voltage input range of ± 50 mV.
- **1C31113G03** provides voltage input range of ± 100 mV.
- **1C31113G04** provides voltage input range of ± 1 V.
- **1C31113G05** provides voltage input range of ± 5 V.
- **1C31113G06** provides voltage input range of ± 10 V.

4.2.2 PERSONALITY MODULES (PMODS)

There are four groups of Personality modules for the Analog Input Module:

- **1C31116G01** provides voltage analog inputs.
- **1C31116G02** provides field-powered current analog inputs.
- **1C31116G03** provides locally powered current analog inputs.
- **1C31116G04** provides voltage analog inputs with a temperature sensor for cold junction thermocouple compensation.

4.2.3 SUBSYSTEMS, ANALOG INPUT (13 BIT)

Analog Input Subsystems (13 Bit)

RANGE	CHANNELS	ELECTRONIC MODULE	PERSONALITY MODULE
± 20mV	8	1C31113G01	1C31116G01
± 50mV	8	1C31113G02	1C31116G01
± 100mV	8	1C31113G03	1C31116G01
± 20mV Compensated (Thermocouple)	8[2]	1C31113G01	1C31116G04
± 50mV Compensated (Thermocouple)	8[2]	1C31113G02	1C31116G04
± 100mV Compensated (Thermocouple)	8[2]	1C31113G03	1C31116G04
± 1 VDC	8	1C31113G04	1C31116G01
± 5 VDC	8	1C31113G05	1C31116G01
± 10 VDC	8	1C31113G06	1C31116G01
0-20 mA Field powered (4-20 mA Field powered can also be selected in the I/O Builder; card is configured appropriately)	8	1C31113G05	1C31116G02
0-20 mA Locally powered (4-20 mA Locally powered can also be selected in the I/O Builder; card is configured appropriately)	8	1C31113G05	1C31116G03

[1] All module configurations listed in the table are CE Mark Certified.

[2] A ninth logical channel (does not connect to a device) is provided when using the Analog Input module with temperature sensor. This ninth point is needed for the **CJ Compensation field** of the Point Builder Instrumentation Tab when defining the eight other thermocouple points for the AI module. (See *Ovation Point Builder User Guide or Ovation Developer Studio User Guide*.)

All Configurations are CE Mark Certified.

4.3 MODULE SPECIFIC INFORMATION

4.3.1 EXTERNAL POWER SUPPLIES

Note: *Module power specifications (main and auxiliary) refer to the actual power drawn by the module from the 24VDC main power supply and from the auxiliary power supply (if required) and* ***NOT*** *from the AC or DC Mains.*

If the Analog Input module uses the 1C31116G03 Personality module (configured with locally powered current analog inputs), the required voltage source may be obtained from the internal auxiliary power supply (backplane) or it may be obtained from an external power supply.

If an external power supply is used, Using an External Power Supply (see page 539) contains steps to be undertaken before connecting the external power supply to the Analog Input module base unit terminal block. The Analog Input module auxiliary supply voltage level (24 VDC or 48 VDC) depends on the external transmitter devices being interfaced to the Analog Input module's analog inputs.

4.3.2 THERMOCOUPLE FUNCTION

When two dissimilar metals (a thermocouple) are joined together, a voltage (the Seebeck Voltage) is generated between them. This voltage is directly related to the temperature at the junction of the two metals. The relationship between the voltage and the temperature can be best described by a fifth order polynomial, determined by the two types of metals that are joined.

To measure the voltage (Vt) between the two metals, a voltmeter (in this case, an analog input card) must be connected to each wire. Unfortunately, this produces two new junctions and voltages (V1 and V2) between the terminals and the thermocouples. The following formula is used to find Vt: Vt = Vm -V1 -V2.

It is not possible to measure V1 and V2 without inducing more junctions and voltages; therefore, the analog input subsystem has a temperature sensor on the Personality module (1C31116G04) to measure the temperature (Tj) at the terminal block of the base unit.

A conversion formula, determined from the junction metal and thermocouple metals, is used to calculate the combined voltage of V1 and V2. This is called **Cold Junction Compensation**.

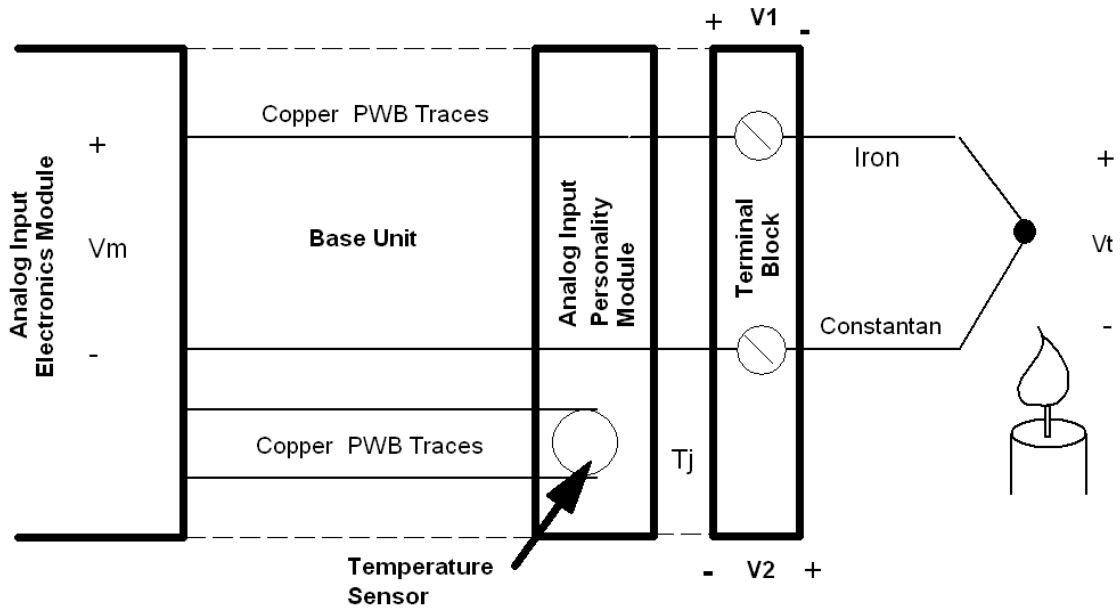


Figure 10: Thermocouple Illustration

Assigning Thermocouple Coefficients

Use the Instrumentation tab of the Point Builder to select the Field Instrumentation Type (B or TB, E or TE, J or TJ, K or TK, R or TR, S or TS, T or TT). The Ovation system then assigns the default thermocouple coefficients based on the Type selected. Refer to the following table for these coefficient definitions.

If you override the default coefficients by entering new values, the new values remain **until** you select another thermocouple type. The values then return to the values for the type just selected.

Thermocouple Coefficient Definitions

Thermocouple Type	Standard Temperature Range	Actual range in MV / TEMP	Best Fit
B or TB	400 to 1100 Degrees C 800 to 2000 Degrees F	0.000 to 13.814 (0 to 1820) 0.006 to 13.814 (0 to 3308)	20 mv card 20 mv card
Fahrenheit COEF_1 = 3.5164700E+02 COEF_2 = 6.1388490E+05 COEF_3 = – 1.5397740E+08 COEF_4 = 3.3593730E+10 COEF_5 = – 4.0518260E+12 COEF_6 = 2.0039330E+14 COEF_7 = – 2.0E-06 COEF_8 = 0.0		**Centigrade** COEF_1 = 1.7758167E+02 COEF_2 = 3.4104717E+05 COEF_3 = – 8.5543000E+07 COEF_4 = – 8.5543000E+07 COEF_5 = – 8.5543000E+07 COEF_6 = 1.1132961E+14 COEF_7 = – 2.0E-06 COEF_8 = 0.0	
E or TE	– 18 to 286 Degrees C 0 to 550 Degrees F – 18 to 661 Degrees C 0 to 1200 Degrees F – 18 to 1000 Degrees C 0 to 1832 Degrees F	– 9.835 to 19.945 (– 270 to 286) – 9.835 to 19.945 (– 450 to 548) – 9.835 to 49.992 (– 270 to 661) – 9.835 to 49.956 (– 450 to 1221) – 9.835 to 76.358 (– 270 to 1000) – 9.835 to 76.358 (– 450 to 1832)	20 mv card 20 mv card 50 mv card 50 mv card 100 mv card 100 mv card
Fahrenheit COEF_1 = 3.1672830E+01 COEF_2 = 3.0306280E+04 COEF_3 = – 3.3449490E+05 COEF_4 = 6.8495880E+06 COEF_5 = – 6.9753490E+07 COEF_6 = 2.9236530E0+08 COEF_7 = – 1.0939E-03 COEF_8 = 3.365E-05		**Centigrade** COEF_1 = – 1.8176111E-01 COEF_2 = 1.6836822E+04 COEF_3 = – 1.8583050E+05 COEF_4 = 3.8053267E+06 COEF_5 = – 3.8751939E+07 COEF_6 = 1.6242517E+08 COEF_7 = – 1.71E-05 COEF_8 = 6.057E-05	
J or TJ	– 18 to 365 Degrees C – 140 to 700 Degrees F – 18 to 760 Degrees C – 140 to 1400 Degrees F	– 8.096 to 19.971 (– 210 to 366) – 8.137 to 19.977 (– 350 to 691) – 8.096 to 42.922 (– 210 to 760) – 8.137 to 42.922 (– 350 to 1400)	20 mv card 20 mv card 50 mv card 50 mv card

Thermocouple Type	Standard Temperature Range	Actual range in MV / TEMP	Best Fit
Fahrenheit COEF_1 = 3.112531E+01 COEF_2 = 3.6070270E+04 COEF_3 = – 4.2886170E+05 COEF_4 = 2.2613820E+07 COEF_5 = – 5.1743790E+08 COEF_6 = 3.9727830E+09 COEF_7 = – 9.256E-04 COEF_8 = 2.862E-05		**Centigrade** COEF_1 = – 4.8593889E-01 COEF_2 = 2.0039039E+04 COEF_3 = – 2.3825650E+05 COEF_4 = 1.2563233E+07 COEF_5 = – 2.8746550E+08 COEF_6 = 2.2071017E+09 COEF_7 = – 9.76E-06 COEF_8 = 5.1516E-05	
K or TK	– 18 to 480 Degrees C 0 to 900 Degrees F – 18 to 1230 Degrees C 0 to 2250 Degrees F – 18 to 1370 Degrees C 0 to 2500 Degrees F	– 6.458 to 19.959 (– 270 to 484) – 6.456 to 19.978 (– 450 to 904) – 6.458 to 49.988 (– 270 to 1232) – 6.456 to 49.996 (– 450 to 2250) – 6.458 to 54.875 (– 270 to 1372) – 6.456 to 54.845 (– 450 to 2500)	20 mv card 20 mv card 50 mv card 50 mv card 100 mv card 100 mv card
Fahrenheit COEF_1 = 3.0344730E+01 COEF_2 = 4.4031910E+04 COEF_3 = 1.615839E+05 COEF_4 = – 1.616257E+07 COEF_5 = 4.4011090E+08 COEF_6 = – 3.599650E+09 COEF_7 = – 7.259E-04 COEF_8 = 2.243E-05		**Centigrade** COEF_1 = – 9.1959444E-01 COEF_2 = 2.4462172E+04 COEF_3 = 8.9768833E+04 COEF_4 = – 8.9792056E+06 COEF_5 = 2.4450606E+08 COEF_6 = – 1.9998056E+09 COEF_7 = – 8.14E-06 COEF_8 = 4.0374E-05	
R or TR	260 to 1100 Degrees C 500 to 2000 Degrees F	0.000 to 19.998 (0 to 1684) 0.089 to 19.997 (0 to 3063)	20 mv card 20 mv card
Fahrenheit COEF_1 = 8.3628480E+01 COEF_2 = 2.2737160E+05 COEF_3 = – 1.2482860E+07 COEF_4 = 1.2062540E+09 COEF_5 = – 7.4221280E+10 COEF_6 = 1.89930000E+12 COEF_7 = – 1.084E-04 COEF_8 = 3.24E-06		**Centigrade** COEF_1 = 2.8682489E+01 COEF_2 = 1.2631756E+05 COEF_3 = – 6.9349222E+06 COEF_4 = 6.7014111E+08 COEF_5 = – 4.1234044E+10 COEF_6 = 1.0551667E+12 COEF_7 = – 4.72E-06 COEF_8 = 5.832E-06	
S or TS	400 to 1100 Degrees C 750 to 2000 Degrees F	0.000 to 18.698 (0 to 1768) -0.092 to 18.696 (0 to 3214)	20 mv card 20 mv card
Fahrenheit COEF_1 = 1.1803440E+02 COEF_2 = 1.9859180E+05 COEF_3 = – 1.9730960E+04 COEF_4 = – 5.0093290E+08 COEF_5 = 4.1104880E+10 COEF_6 = – 1.1557940E+12 COEF_7 = – 1.0847E-04 COEF_8 = 3.26E-06		**Centigrade** COEF_1 = 4.7796889E+01 COEF_2 = 1.1032878E+05 COEF_3 = – 1.0961644E+04 COEF_4 = – 2.7829606E+08 COEF_5 = 2.2836044E+10 COEF_6 = – 6.4210778E+11 COEF_7 = – 4.15E-06 COEF_8 = 5.868E-06	
T or TT	-46 to 400 Degrees C -50 to 750 Degrees F	-6.258 to 19.945 (-270 to 385) -6.254 to 19.979 (-450 to 726)	20 mv card 20 mv card

Thermocouple Type	Standard Temperature Range	Actual range in MV / TEMP	Best Fit
Fahrenheit COEF_1 = 3.1892240E+01 COEF_2 = 4.6693280E+04 COEF_3 = – 1.3257390E+06 COEF_4 = 6.9620670E+07 COEF_5 = – 2.3278080E+09 COEF_6 = 3.3306460E+10 COEF_7 = – 7.3333E-04 COEF_8 = 2.243E-05		**Centigrade** COEF_1 = – 5.9866667E-02 COEF_2 = 2.5940711E+04 COEF_3 = – 7.3652167E+05 COEF_4 = 3.8678150E+07 COEF_5 = – 1.2932267E+09 COEF_6 = 1.8503589E+10 COEF_7 = – 1.55700E-05 COEF_8 = 4.0374E-05	

4.4 WIRING INFORMATION

4.4.1 13-BIT ANALOG INPUT TERMINAL BLOCK WIRING INFORMATION

Each Personality module has a simplified wiring diagram label on its side, which appears above the terminal block. This diagram indicates how the wiring from the field is to be connected to the terminal block in the base unit.

The diagrams for the analog input Personality modules are illustrated in the following figure. The following table lists and defines the abbreviations used in those diagrams.

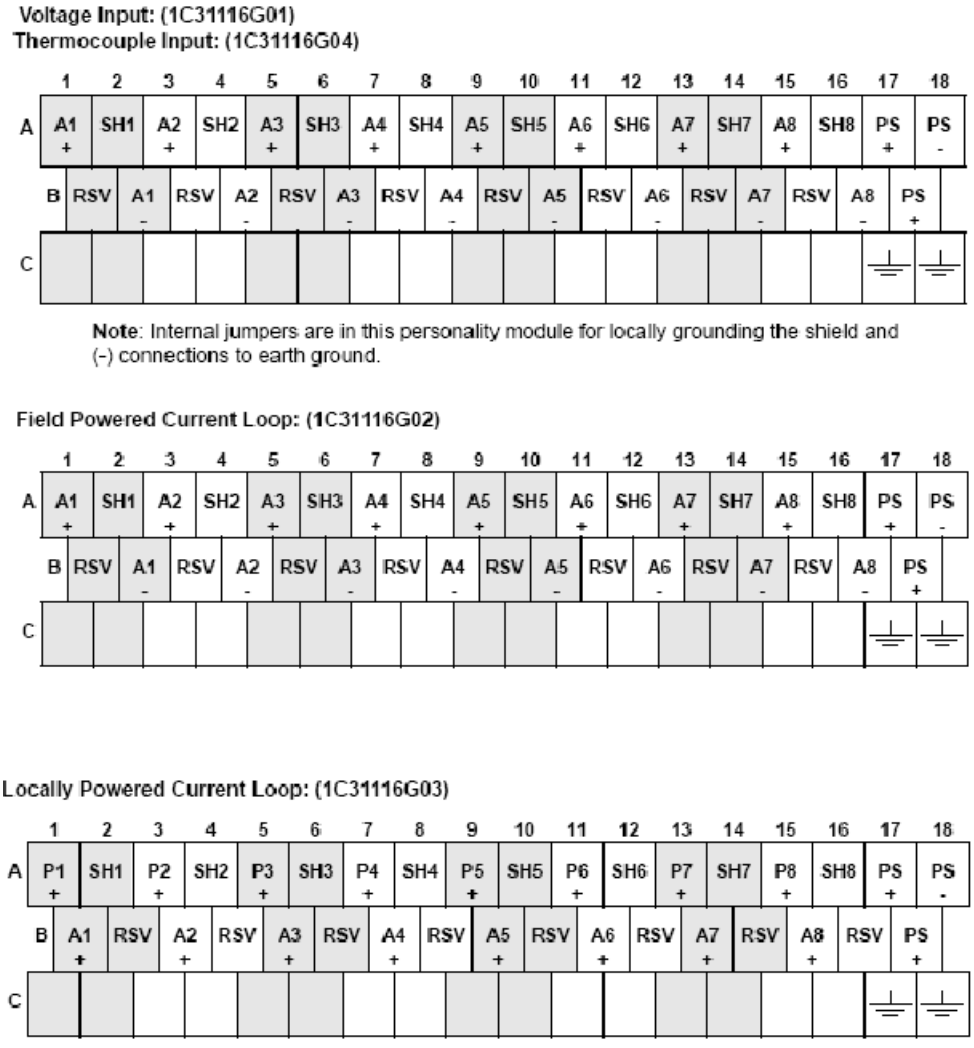

Voltage Input: (1C31116G01)
Thermocouple Input: (1C31116G04)
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18
A A1 + SH1 A2 + SH2 A3 + SH3 A4 + SH4 A5 + SH5 A6 + SH6 A7 + SH7 A8 + SH8 PS + PS -
B RSV A1 - RSV A2 - RSV A3 - RSV A4 - RSV A5 - RSV A6 - RSV A7 - RSV A8 - PS +
C
Note: Internal jumpers are in this personality module for locally grounding the shield and (-) connections to earth ground.
Field Powered Current Loop: (1C31116G02)
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18
A A1 + SH1 A2 + SH2 A3 + SH3 A4 + SH4 A5 + SH5 A6 + SH6 A7 + SH7 A8 + SH8 PS + PS -
B RSV A1 - RSV A2 - RSV A3 - RSV A4 - RSV A5 - RSV A6 - RSV A7 - RSV A8 - PS +
C
Locally Powered Current Loop: (1C31116G03)
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18
A P1 + SH1 P2 + SH2 P3 + SH3 P4 + SH4 P5 + SH5 P6 + SH6 P7 + SH7 P8 + SH8 PS + PS -
B A1 + RSV A2 + RSV A3 + RSV A4 + RSV A5 + RSV A6 + RSV A7 + RSV A8 + RSV PS +
C

Figure 11: Terminal Block Connections for the Analog Input Personality Modules

As is standard for analog signals, shielded twisted-pair wire should be used for the field interface. For the analog input, the (-) and shield should be tied together and to earth ground, either locally at the cabinet or at the field device.

Abbreviations Used in Diagrams

ABBREVIATION	DEFINITION
A1 - A8 +	Analog Input positive terminal connection
A1 - A8 -	Analog Input negative terminal connection
	Earth ground terminals
P1 - P8 +	Positive terminal connection for current loop power
PS+, PS-	Auxiliary power supply terminals
RSV	Reserved terminal. No connections allowed on these terminals.
SH1 - SH8	Shield terminal connection (for non-CE Mark certified systems)

Note: *Do **not** use unmarked terminal block locations.*

*Shield terminals (SH) are **not** connected in CE Mark systems.*

4.4.2 13-BIT ANALOG INPUT FIELD CONNECTION WIRING DIAGRAMS (NON-CE MARK CERTIFIED)

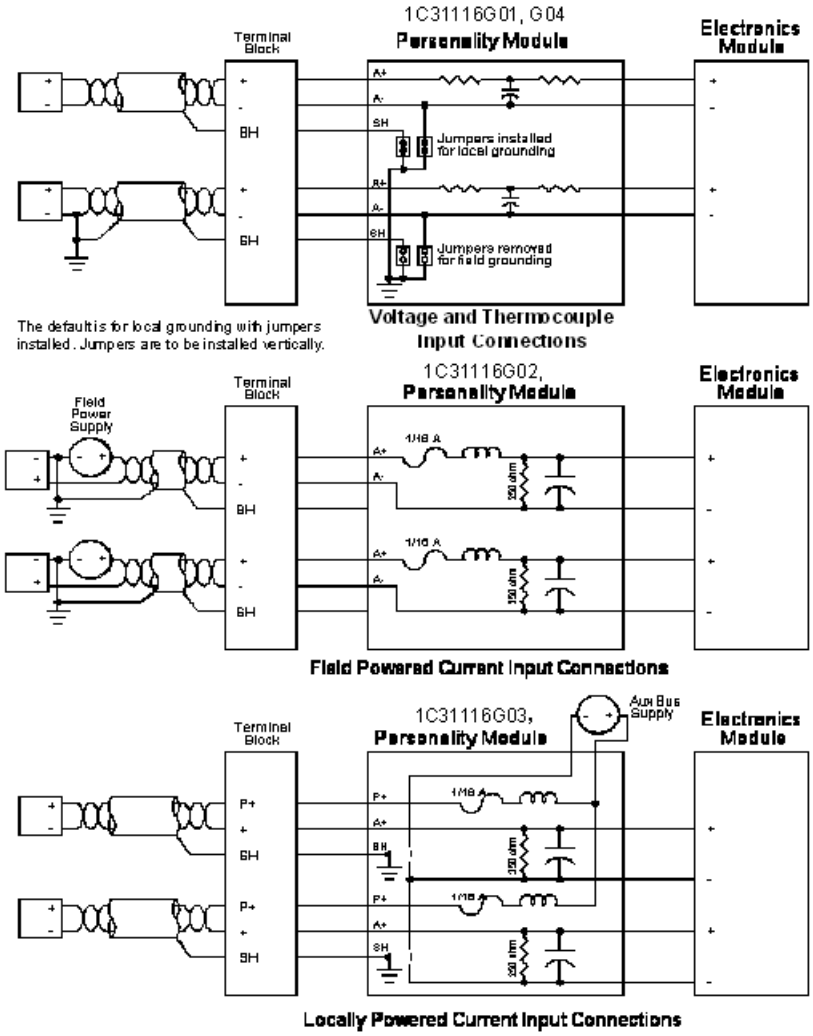
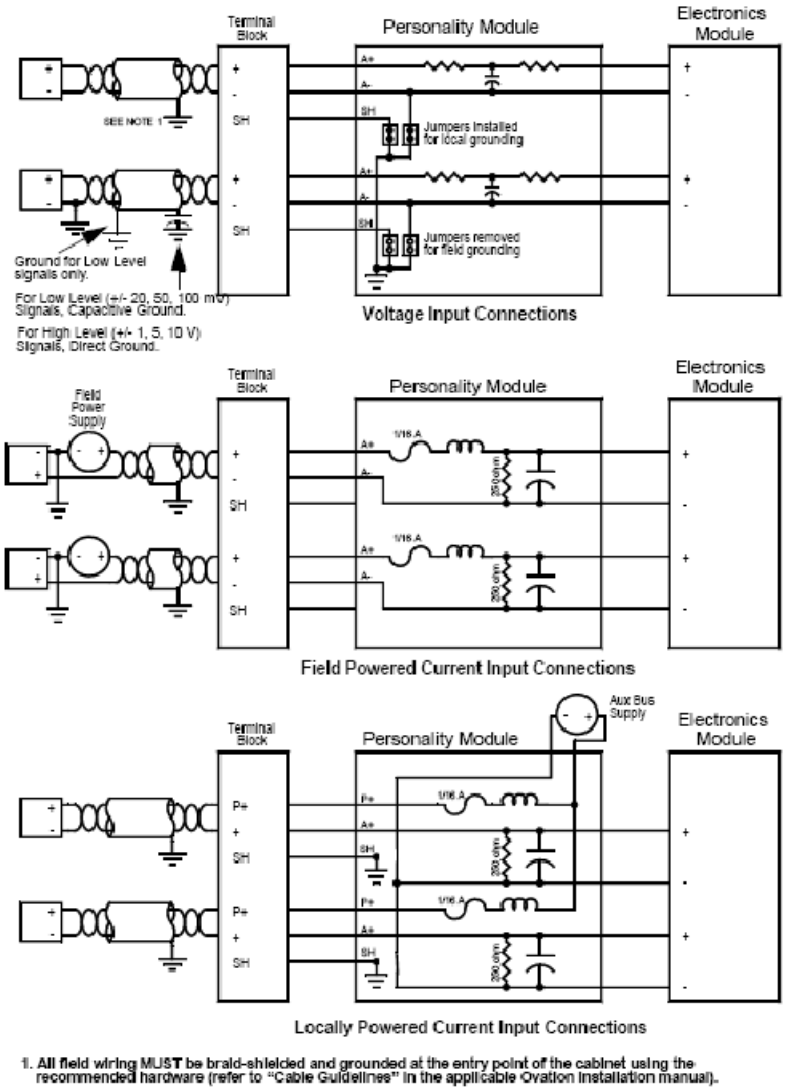


Figure 12: Field Connections, Analog Input Personality Module (Non-CE Mark)

Note: *See Personality Module Jumpers (see page 33) for details on accessing the jumpers.*

4.4.3 13-BIT ANALOG INPUT FIELD CONNECTION WIRING DIAGRAMS (CE MARK CERTIFIED)


Terminal Block
Personality Module
Electronics Module
SEE NOTE 1
Jumpers installed for local grounding
Jumpers removed for field grounding
Ground for Low Level signals only.
For Low Level (+/- 20, 50, 100 mV) Signals, Capacitive Ground.
For High Level (+/- 1, 5, 10 V) Signals, Direct Ground.
Voltage Input Connections
Field Power Supply
Field Powered Current Input Connections
Aux Bus Supply
Locally Powered Current Input Connections

1. All field wiring MUST be braid-shielded and grounded at the entry point of the cabinet using the recommended hardware (refer to "Cable Guidelines" in the applicable Ovation installation manual).

Figure 13: Field Connections for the Analog Input Personality Module (CE Mark)

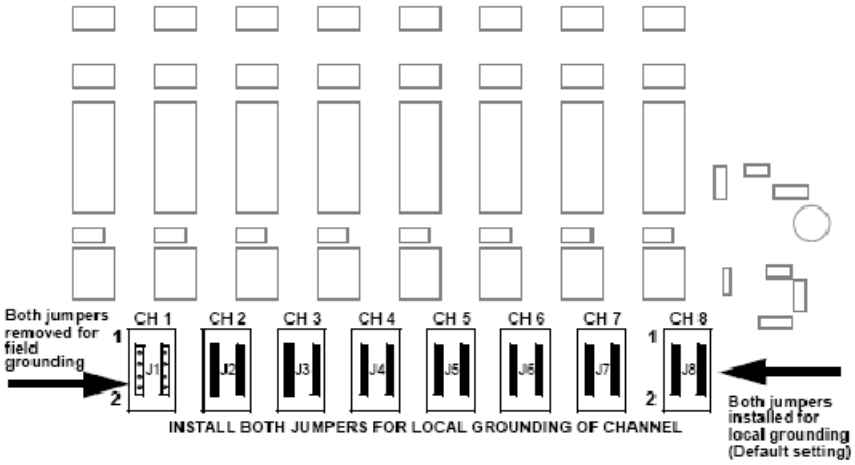


Figure 14: Jumper Settings for Analog Input Personality Module (1C31116G01 & 04)

Note: *The circuit board must be removed from the module housing to access the jumpers (see page 33).*

4.5 Address Location Information

4.5.1 Configuration and Status Register

Word address 13 (D in Hex) is used to configure the module and provide status information to the Controller. The status register can be read by using the Point Information window at an Operator Station (see the Bit Pattern field on the Hardware tab). (See the *Ovation Operator Station User Guide*.)

Analog Input Configuration/Status Register (Address 13 or D in Hex)

Bit	Data Description - Configuration Register (Write)	Data Description - Status Register (Read)
0	Configure Module	Module Configured (1 = configured; 0 = unconfigured)
1	Force Error	Internal or forced error (1 = forced error; 0 = no forced error)
2	Not Used	Not Used (0)
3	Not Used	Not Used (0)
4	Not Used	Not Used (0)
5	Not Used	Not Used (0)
6	Not Used	Not Used (0)
7	Not Used	EEPROM Checksum Error - Module Uncalibrated (1 = error; 0 = no error)
8	50/60 Hz Selection (0 = 60Hz, 1 = 50Hz)	50 Hz/60 Hz System (0 = 60Hz; 1 = 50Hz)

9	Use Line Sync if Present (1 = use)	Using Line Sync
10	Not Used	Line Frequency Tracking Active
11	Not Used	EE PROM Program Enabled
12	Not Used	PSD Generator Malfunction
13	Not Used	Internal Memory Error (EPROM Checksum or Static RAM Error)
14	Not Used	Temperature Sensor Failure
15	Not Used	Point Fault [1]
[1] Refer to Point Quality Registers (see page 51) for descriptions of the Point Faults.		

Bit 0: This bit configures the module (write) or indicates the configuration state of the module (read). A “1” indicates that the module is configured. Note that until the module is configured, accessing addresses 0 through 11 (B in Hex) produces an attention status.

Bit 1: This bit (write “1”) forces the module into its error state, resulting in the error LED being lit. The read of bit 1 indicates the error state of the module, with “1” indicating that there is an internal error in the module or the Controller has forced the module into an error state. The state of this bit is always reflected by the module's Internal Error LED. Whenever this bit is set, an attention status is returned to the Controller when the point data is read (that is, accessing addresses 0 through 11).

Bits 2 - 6: These bits are “not used” values and are read as “0” under normal operation.

Bit 7: This bit is the result of a checksum test of the EEPROM. A failure of this test can indicate a bad EEPROM, but typically indicates that the module has not been calibrated. A “0” indicates that there is no error condition. If this error is present, the error is indicated by the module error LED being lit and the module does not process the point information. The point fault bit is also set as all the point data is uncalibrated. When this error is present, no other processing takes place. The “1” state of this bit indicates an unrecoverable error condition in the field.

Bit 8: This bit indicates if the on-board integrating timebase is 80 msec (4 line cycles of a 50 Hz system) or 83.3 msec (5 line cycles of a 60 Hz system). A “0” indicates that the timebase is 83.3 msec (60 Hz line frequency) and is the default setting.

Bit 9: This bit indicates whether to use the line frequency tracking if it is present. A write of “1” indicates to use the tracking input. A read of “1” indicates that the module is using the tracking input. The default state is a “0.”

Note: *Line frequency tracking is presently* ***NOT*** *supported by the Ovation I/O system.*

Bit 10: This bit indicates whether the line frequency tracking signal is present and active for greater normal and common mode rejection. A “0” indicates that the line frequency tracking signal is NOT present.

Bit 11: This bit indicates whether the hardware EEPROM PE signal is active. A “0” indicates that the module is in normal operating mode and calibration and ID programming commands are not processed.

Bit 12: This bit reflects the detection of the internal 625 KHz PSD signal at module initialization. This verifies that the multifunction FPGA and the microcontroller's timer 0 are functioning. A “0” indicates that there is no error condition. A “1” indicates an unrecoverable error condition in the field.

Bit 13: This bit is a basic check of program and data memory, along with the microcontroller's data, address, and control buses. A “0” indicates that there is no error condition. A “1” indicates an unrecoverable error condition in the field.

Bit 14: This bit indicates the fault status of the digital temperature sensor. A “0” indicates the sensor is present and communicating properly with the microcontroller. A “1” indicates a fault exists; either there is no sensor present, or problems exist in communicating with the sensor. On an uncalibrated module, a sensor failure is always reported because the uncalibrated status prevents the sensor from being checked.

Bit 15: This bit indicates the point fault status of the module. It is the logical “OR” of the eight individual point quality statuses plus bits 1, 7, 12, and 13 of this register. A “0” indicates that all eight points have good quality and no module errors exist. A “1” indicates that at least one of the points has bad quality and is therefore in fault.

A subsequent read of the Point Quality Status Register (see page 51) at Address 12 (C in Hex) reveals which of the eight points has bad quality and the cause of the bad quality condition. The Address 12 (C in Hex) Point Quality Status Register contains data only when the module fault is due to a bad point quality; that is, bits 7, 12, and 13 of this register or the forced error bit are not set. Note that the Temperature Sensor (Address 8) status is treated separately and is not included in this module point fault bit.

Secondary Configuration and Status Register

Word address 14 (E in Hex) serves the purpose of the Current/Voltage Configuration/Status Register. The bit definitions for this register are encoded as shown in the following table.

The default state of the register under normal operation is “0” for voltage inputs. The lower 8 bits are configuration bits which are written to and read from the module. The upper 8 bits are read-only status bits indicating the blown fuse status only for those channels which have been configured as current inputs.

Secondary Configuration/Status Register (Address 14 or E in Hex)

BIT	DATA DESCRIPTION - CURRENT/VOLTAGE CONFIGURATION (WRITE)	DATA DESCRIPTION - CURRENT/VOLTAGE STATUS (READ)
0	Select Point 1 Current/Voltage (1 = Current)	Select Point 1 Current/Voltage (1 = Current)
1	Select Point 2 Current/Voltage (1 = Current)	Select Point 2 Current/Voltage (1 = Current)
2	Select Point 3 Current/Voltage (1 = Current)	Select Point 3 Current/Voltage (1 = Current)
3	Select Point 4 Current/Voltage (1 = Current)	Select Point 4 Current/Voltage (1 = Current)
4	Select Point 5 Current/Voltage (1 = Current)	Select Point 5 Current/Voltage (1 = Current)
5	Select Point 6 Current/Voltage (1 = Current)	Select Point 6 Current/Voltage (1 = Current)
6	Select Point 7 Current/Voltage (1 = Current)	Select Point 7 Current/Voltage (1 = Current)
7	Select Point 8 Current/Voltage (1 = Current)	Select Point 8 Current/Voltage (1 = Current)
8	Not Used	Point 1 Current Blown Fuse (1 = Blown)
9	Not Used	Point 2 Current Blown Fuse (1 = Blown)
10	Not Used	Point 3 Current Blown Fuse (1 = Blown)

11	Not Used	Point 4 Current Blown Fuse (1 = Blown)
12	Not Used	Point 5 Current Blown Fuse (1 = Blown)
13	Not Used	Point 6 Current Blown Fuse (1 = Blown)
14	Not Used	Point 7 Current Blown Fuse (1 = Blown)
15	Not Used	Point 8 Current Blown Fuse (1 = Blown)

Point Quality Register

Word address 12 (C in Hex) serves the purpose of reporting the point quality of the eight channel inputs. The bit definitions for this register are encoded as shown in the following table.

Point Quality Register (Address 12 or C in Hex)

Point	Bit	Description
1	0	Auto Calibration Reasonability Check Failed
	1	Overrange Input/Blown Fuse/Open Loop/Open Thermocouple
2	2	Auto Calibration Reasonability Check Failed
	3	Overrange Input/Blown Fuse/Open Loop/Open Thermocouple
3	4	Auto Calibration Reasonability Check Failed
	5	Overrange Input/Blown Fuse/Open Loop/Open Thermocouple
4	6	Auto Calibration Reasonability Check Failed
	7	Overrange Input/Blown Fuse/Open Loop/Open Thermocouple
5	8	Auto Calibration Reasonability Check Failed
	9	Overrange Input/Blown Fuse/Open Loop/Open Thermocouple
6	10	Auto Calibration Reasonability Check Failed
	11	Overrange Input/Blown Fuse/Open Loop/Open Thermocouple
7	12	Auto Calibration Reasonability Check Failed
	13	Overrange Input/Blown Fuse/Open Loop/Open Thermocouple
8	14	Auto Calibration Reasonability Check Failed
	15	Overrange Input/Blown Fuse/Open Loop/Open Thermocouple

Auto Calibration Reasonability Check Failed - This bit is set when the auto calibration zero or reference reading is out of tolerance (±6% of the nominal reading).

Overrange Input/Blown Fuse/Open Loop/Open Thermocouple - This bit is set under the following conditions:

- **Voltage Input Configuration** (all groups) - when an overrange input of ±125% of the full scale value is read on the input.
- **Current Input Configuration** (Group 5) - when an input less than 2.5mA (a blown fuse or open loop condition) is detected or an overrange of greater than 25mA of full scale is present.

4.6 DIAGNOSTIC LEDS

The following table lists the module's LEDs and describes what they mean when lit.

Analog Input Diagnostic LEDs

LED	DESCRIPTION
P (Green)	Power OK LED. Lit when the +5V power is OK.
C (Green)	Communications OK LED. Lit when the Controller is communicating with the module.
I (Red)	Internal Error LED. Lit whenever there is any type of error with the module **except** for a loss of power. Possible causes are: ▪ Module is initialization. ▪ I/O Bus timeout has occurred. ▪ EPROM checksum error or static RAM error. ▪ PSD generator malfunction. ▪ Module reset. ▪ Module input power (+24V) not OK. ▪ Module is uncalibrated. ▪ Forced error has been issued by the Controller.
CH1 - CH 8 (Red)	Channel error. Lit whenever there is an error associated with a channel or channels. Possible causes are: ▪ Positive overrange: Input voltage greater than +125% of full scale value. ▪ Negative overrange: Input voltage less than -125% of full scale value. ▪ Broken current loop input or blown fuse for module configured as current input. ▪ Auto calibration readings out of range.

4.7 SPECIFICATIONS

Electronics Module (1C31113)

Personality Module (1C31116)

Analog Input Module Specifications

DESCRIPTION	VALUE
Number of channels	8
Input range [1]	±20 mv ±1 V ±50 mv ±5 V ±100 mv ±10 V 4 - 20 mA [2]
Resolution	13 bits (including polarity)
Guaranteed accuracy (@25°C)	Accuracy over -25% to 100% range of full scale input level: ▪ ±0.10% of upper range value ±10µV ±1/2LSB @99.7% confidence. ▪ Accuracy over -100% to -25% range of full scale input level: ▪ ±0.15% of upper range value ±10µV ±1/2LSB @99.7% confidence.
Temperature coefficient	±0.24% of the upper range value ±24µV over 0 to 60°C.
Input impedance: [3] Groups G01 through G05 Group G06 (± 10V input only)	 10 M-ohms 2 M-ohms
Sampling rate	10 times per second
Offset and gain temperature drift compensation	Automatic
Diagnostics	Internal module operating faults. ▪ Out of range detection. ▪ Open thermocouple detection for thermocouple inputs. ▪ Open loop/blown fuse detection for current inputs.
Dielectric isolation: Channel to channel Channel to logic	 1000 V AC/DC 1000 V AC/DC
Normal mode rejection	60 dB at 50 Hz ± 1/2% or 60 Hz ± 1/2% 30 dB (typical) at 50 Hz ± 5% or 60 Hz ± 5%
Common mode rejection	120 dB at DC, power line frequency and its harmonics ± 1/2% tracking. 100 dB (typical) for nominal line frequency ± 5% and harmonics.
Module power	Main: 2.5 W typical; 3.38 W maximum Aux: When used (1C31116G03) Aux power supply voltage = 24 V DC 3.84 W typical (8 inputs @ 20mA each)

DESCRIPTION	VALUE
Operating temperature range	0 to 60°C (32°F to 140°F)
Storage temperature range	-40°C to 85°C (-40°F to 185°F)
Humidity (non-condensing)	0 to 95%

[1] Ranges are available via separate modules.

[2] Current inputs when using Personality module 1C31116G02 or 1C31116G03 with ± 5V electronics module.

The input range 0 to 20 mA is also available, but if selected, blown fuse detection will be disabled. If you select 0 to 20 mA, the software adds a suffix “A” to the Personality module identification. This “A” is not displayed, it is only used by the database to differentiate between 0 to 20 mA and 4 to 20 mA, in order to generate correct coefficients.

[3] Only for modules used with voltage input Personality modules (1C1116G01 and 1C1116G04).

SECTION 5

ANALOG INPUT MODULE (14 BITS)

IN THIS SECTION

Description *55*
Module Group Information *55*
Module Specific Information *56*
Wiring Information *57*
Address Location Information *60*
Diagnostic LEDs *63*
Specifications *64*

5.1 DESCRIPTION

The combined Personality and Electronics Modules form the 14 Bit Analog Input Module. Eight sets of individually isolated input channels are provided. The input signals are conditioned and routed through the appropriate Personality Module to the Electronics Module. The Personality Module also provides surge protection to protect the input circuits of the Electronics Module. The Electronics Module performs the analog to digital conversions and provides interfacing to the Ovation Serial I/O Bus.

No thermocouple provisions are provided for this module.

Note: *I/O Module General Information (see page 15) contains environmental, installation, wiring, and fuse information for I/O modules.*

5.2 MODULE GROUP INFORMATION

5.2.1 ELECTRONICS MODULES (EMODS)

There are two groups of Electronics modules for the 14 Bit Analog Input Module:

- **1C31224G01** provides current signals with an input range of 4 to 20 mA.
- **1C31224G02** provides voltage signals with an input range of ± 1V.

5.2.2 PERSONALITY MODULES (PMODS)

There are two groups of Personality modules for the 14 Bit Analog Input Module:

- **1C31227G01** provides current signals with an input range of 4 to 20 mA.
- **1C31227G02** provides voltage signals with an input range of ± 1V.

5.2.3 SUBSYSTEMS, ANALOG INPUT (14 BIT)

Analog Input Subsystems (14 Bit)

RANGE	CHANNELS	ELECTRONIC MODULE	PERSONALITY MODULE
4 - 20mA, Field or Locally powered	8	1C31224G01	1C31227G01
± 1 VDC	8	1C31224G02	1C31227G02
Only 4-20mA Configuration is CE Mark Certified.			

5.3 MODULE SPECIFIC INFORMATION

5.3.1 MODULE BLOCK DIAGRAM

The simplified block diagram for the voltage input configuration of the14 bit Analog Input module is shown in the following figure. The channel 1 input is grounded locally at the cabinet, and grounding at the field device is shown for the channel 8 input.

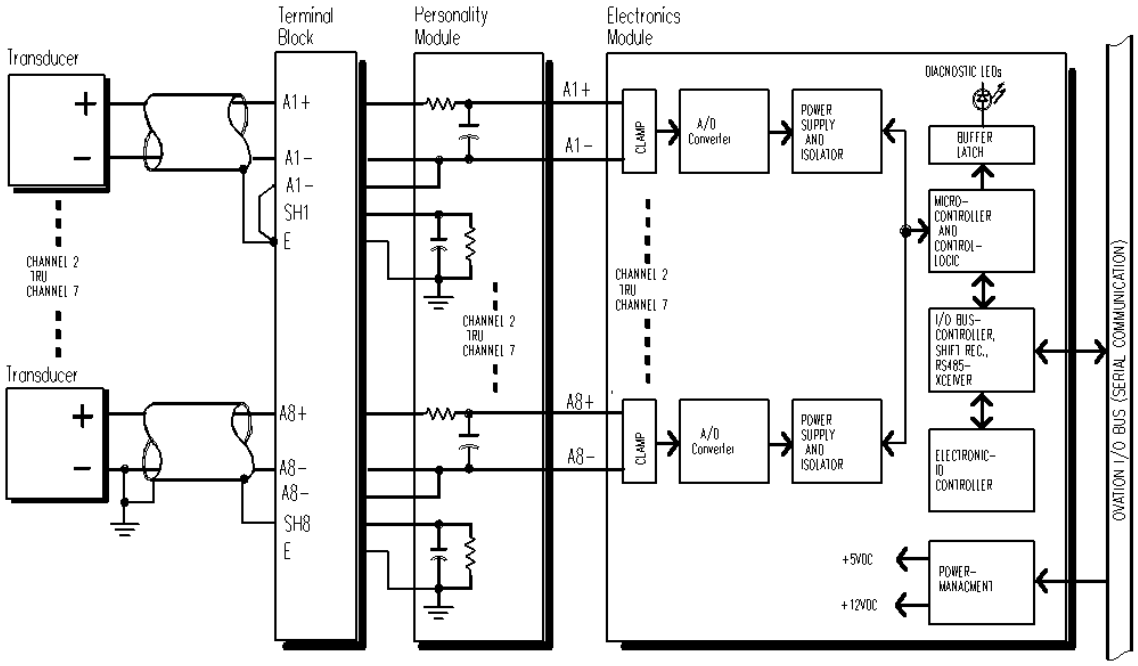


Figure 15: Voltage Input Connections

5.3.2 EXTERNAL POWER SUPPLIES

Note: *Module power specifications (main and auxiliary) refer to the actual power drawn by the module from the 24VDC main power supply and from the auxiliary power supply (if required) and* ***NOT*** *from the AC or DC Mains.*

If the 14 Bit Analog Input module uses the 1C31227G01 Personality module, the required voltage source is obtained from the internal auxiliary power supply (backplane).

Also, personality module 1C31227G01 supports field-powered configurations.

5.4 WIRING INFORMATION

5.4.1 14-BIT ANALOG INPUT TERMINAL BLOCK WIRING INFORMATION

Each Personality module has a simplified wiring diagram label on its side, which appears above the terminal block. This diagram indicates how the wiring from the field is to be connected to the terminal block in the base unit.

The diagrams for the analog input Personality modules are illustrated in the following figure. The following table lists and defines the abbreviations used in those diagrams.

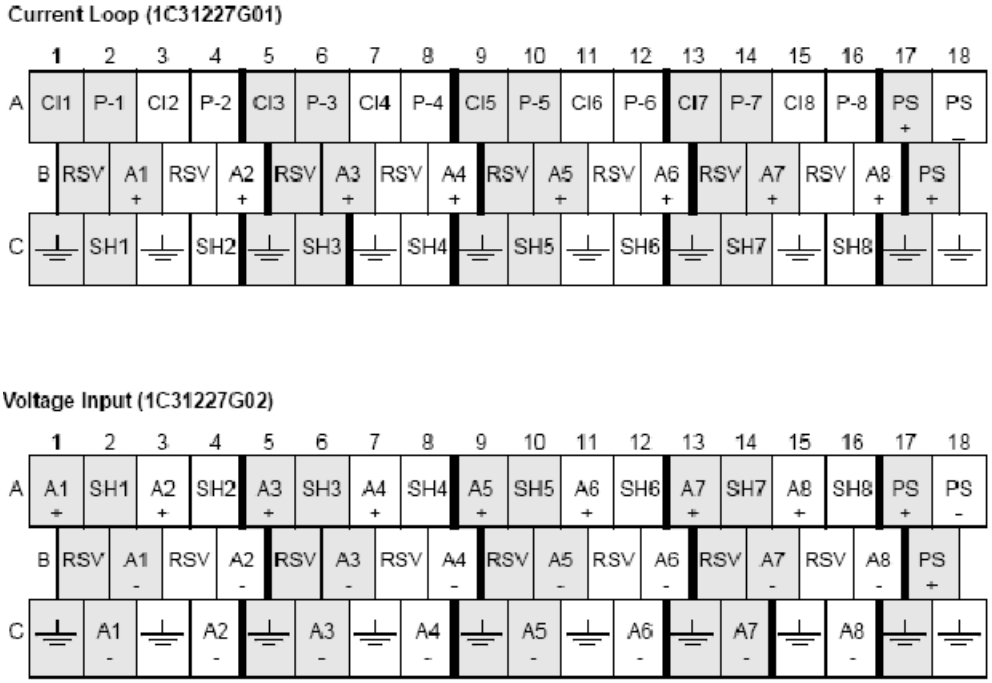

Current Loop (1C31227G01)
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18
A CI1 P-1 CI2 P-2 CI3 P-3 CI4 P-4 CI5 P-5 CI6 P-6 CI7 P-7 CI8 P-8 PS + PS –
B RSV A1 + RSV A2 + RSV A3 + RSV A4 + RSV A5 + RSV A6 + RSV A7 + RSV A8 + PS +
C SH1 SH2 SH3 SH4 SH5 SH6 SH7 SH8
Voltage Input (1C31227G02)
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18
A A1 + SH1 A2 + SH2 A3 + SH3 A4 + SH4 A5 + SH5 A6 + SH6 A7 + SH7 A8 + SH8 PS + PS -
B RSV A1 - RSV A2 - RSV A3 - RSV A4 - RSV A5 - RSV A6 - RSV A7 - RSV A8 - PS +
C A1 - A2 - A3 - A4 - A5 - A6 - A7 - A8 -

Figure 16: Terminal Block Connections for the Analog Input Personality Modules

Abbreviations Used in Diagrams

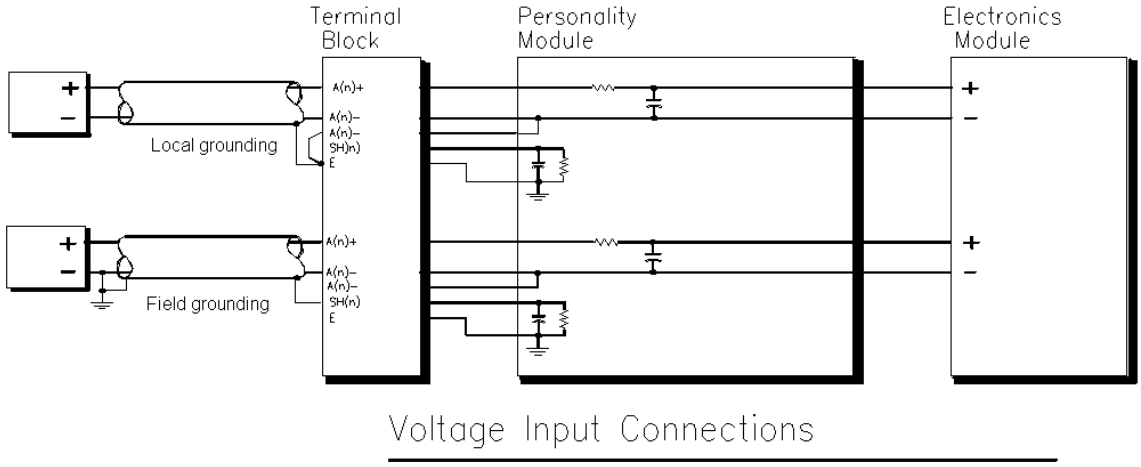
ABBREVIATION	DEFINITION
A1 - A8 +	Analog Input positive terminal connection (connected to the positive terminal of the field device).
A1 - A8 -	Analog Input negative terminal connection (voltage input group only).
P-1 - P-8	Loop power output terminals (for locally powered loops).
CI1 - CI8	Current input terminals.
SH1 - SH8	Shield terminal connection.
RSV	Reserved terminal. No connections allowed on these terminals.
	Earth ground terminals.
PS+, PS-	Auxiliary power supply terminals.

Use shielded twisted pair wire for the field wiring. Tie the Analog Input negative terminal and shield together and to earth ground, either locally at the cabinet or at the field device. Voltage inputs use the 1C31227G02 Personality Modules. Grounding the shield and the analog input negative terminal at the cabinet or at the field device is arranged by the proper Terminal Block connections.

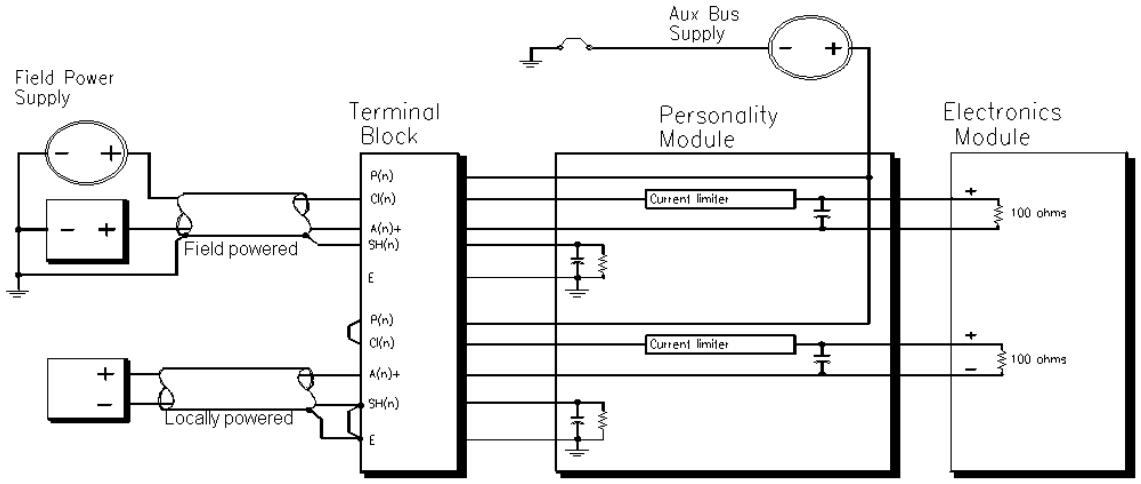
Similarly, current inputs using the 1C31227G01 Personality Modules can accommodate field or locally powered devices by using the correct terminal block connections.

The Personality Modules have a field connection diagram label on top of each module to facilitate field wiring. The figures in 14-Bit Analog Input Field Connection Wiring Diagrams (Non-CE Mark Certified) (see page 59) show the implementations of the field connections for the various Personality Module and field device combinations.

5.4.2 14-BIT ANALOG INPUT FIELD CONNECTION WIRING DIAGRAMS (NON-CE MARK CERTIFIED)



Voltage Input Connections



Current Input Connections

Caution

When using locally powered current inputs, the power distribution panel MUST be equipped with jumper module 5A26471G01 to ensure proper grounding of the aux Bus supply.

Figure 17: Field Connections for the Input Connectors (Non-CE Mark)

5.4.3 14-Bit Analog Input Field Connection Wiring Diagrams (CE Mark Certified)

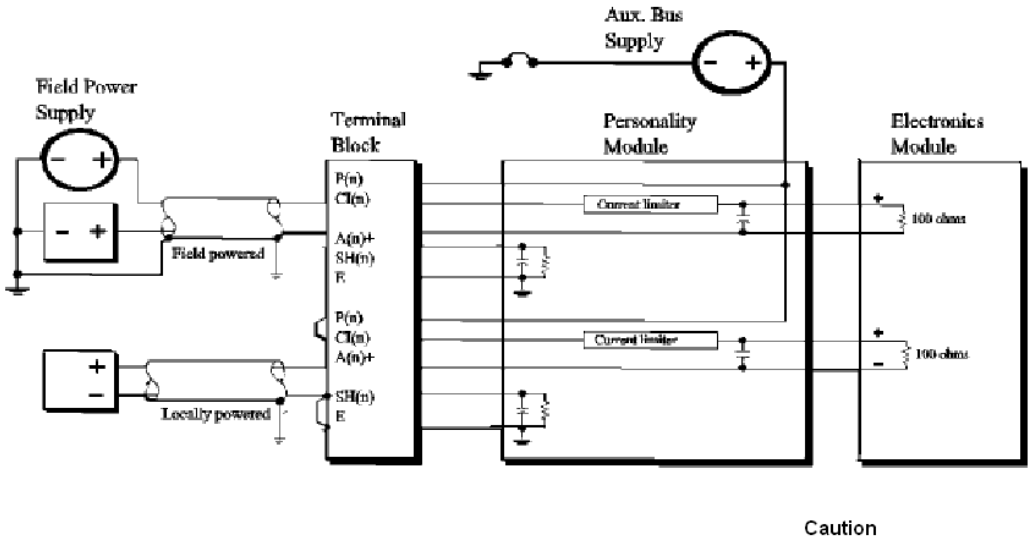


Figure 18: Field Connections for the Input Connectors (CE Mark)

5.5 Address Location Information

5.5.1 Configuration and Status Register

Word address 13 (D in Hex) is used to configure the module and provide status information to the Controller. The status register can be read by using the Point Information window at an Operator Station (See the *Operator Station User Guide*).

14-Bit Analog Input Configuration/Status (Address 13 or D in Hex)

Bit	Data Description - Configuration Register (Write)	Data Description - Status Register (Read)
0	Configure Module	Module Configured (1 = configured; 0 = unconfigured)
1	Force Error	Internal or forced error (1 = forced error; 0 = no forced error)
2	0, (ADD4 bit during diagnostics)	Not Used (0)
3	0, (ADD5 bit during diagnostics)	Not Used (0)
4	0, (ADD6 bit during diagnostics)	Warming
5	0, (ADD7 bit during diagnostics)	Not Used (0)

BIT	DATA DESCRIPTION - CONFIGURATION REGISTER (WRITE)	DATA DESCRIPTION - STATUS REGISTER (READ)
6	0, (ADD8 bit during diagnostics)	Not Used (0)
7	0, (DIAG_SET, initiates diagnostics)	Module is not calibrated
8	50/60 Hz Selection (0 = 60Hz, 1 = 50Hz)	50 Hz/60 Hz System (0 = 60Hz; 1 = 50Hz)
9	A/D conversion rate selection bit (0 = Normal, 1 = High speed)	A/D conversion rate bit (0 = Normal, 1 = High speed)
10	0, (SYS_CAL, initiates system calibration during diagnostics)	SYS_CAL in progress (during diagnostics)
11	SELF_CAL (initiates self calibration)	SYS_CAL completed (during diagnostics)
12	Not defined	SYS_CAL failed (during diagnostics)
13	Not defined	Internal Memory Error (FLASH Checksum, Register, or Static RAM Error)
14	Not defined	Module in diagnostic mode (during diagnostics)
15	Not defined	Point Fault [1]
[1] Refer to the Point Quality Register for descriptions of the Point Faults.		

Bits defined for diagnostics are used only during factory testing.

Bit 0: This bit configures the module (write) or indicates the configuration state of the module (read). A “1” indicates that the module is configured. Note that until the module is configured, reading from addresses 0 through 11 (B in Hex) produces an attention status.

Bit 1: This bit (write “1”) forces the module into its error state, resulting in the error LED being lit. The read of bit 1 indicates that there is an internal module error, or the Controller has forced the module into the error state. The state of this bit is always reflected by the module's Internal Error LED. Whenever this bit is set, an attention status is returned to the Controller when addresses 0 through 11 (B in Hex) are read.

Bits 2-3: These bits are not used and are read as “0” under normal operation.

Bit 4: This bit (read) indicates that the module is in the “Warming” state. This state exists after power up and terminates after 8.16 seconds. The module is in the error condition during the warm up period.

Bits 5-6: These bits are not used and are read as “0” under normal operation.

Bit 7: This bit is the result of a checksum test of the EEPROM. A failure of this test can indicate a bad EEPROM, but typically indicates that the module has not been calibrated. A “0” indicates that there is no error condition. If an error is present, the error is indicated by the module error LED being lit. The point fault bit is set as all the point data is not calibrated. The “1” state of this bit indicates an unrecoverable error condition in the field.

Bits 8: A write to this bit configures the conversion rate of the A/C converters as follows:

CONVERSION RATE (1/SEC)	BIT 8
20 (for 60Hz systems)	0
25 (for 50Hz systems)	1

The status of these bits (read) indicate the conversion rate to which the module is set.

Bit 9: Reserved

Bit 10: This bit is not used and is read as “0” under normal operation.

Bit 11: This bit (write) is used to initiate self-calibration. The sampling rate during self-calibration will be 2 per second. The status (read) bit is not used and is read as “0” under normal operation.

Bit 12: This bit is not used and is read as “0” under normal operation.

Bit 13: This bit (read) indicates that the module has internal memory error (FLASH, checksum, Register, or Static RAM error). If this error is present, the module error LED is lit, the point fault bit is also set since the condition of the module is undetermined.

Bit 14: This bit is not used and is read as “0” under normal operation.

Bit 15: This bit indicates the point fault status of the module. It is the logical “OR” of the eight individual point quality statuses plus bits 1, 7, 12, and 13 of this register. A “0” indicates that all eight points have good quality and no module errors exist.

When bits 1, 4, 7 or 13 of the Status Register are not set, this bit (when set to “1”) indicates that at least one of the points has bad quality.

A subsequent read of the Point Quality Register at Address 12 (C in Hex) reveals the point(s) that have bad quality (see the following table). The Address 12 (C in Hex) Point Quality Register contains data only when the module fault is due to a bad point quality.

Secondary Configuration and Status Register

Word address 14 (E in Hex) is not used and is read as “0” under normal operation.

Point Quality Register

Word address 12 (C in Hex) serves the purpose of reporting the point quality of the eight channel inputs. The bit definitions for this register are encoded as shown in the following table.

Point Quality Register (Address 12 or C in Hex)

POINT	BIT	DESCRIPTION
1	0	Communication to the Isolated Channel Failed
	1	Overrange Input/Blown Fuse/Open Loop
2	2	Communication to the Isolated Channel Failed
	3	Overrange Input/Blown Fuse/Open Loop
3	4	Communication to the Isolated Channel Failed
	5	Overrange Input/Blown Fuse/Open Loop
4	6	Communication to the Isolated Channel Failed
	7	Overrange Input/Blown Fuse/Open Loop
5	8	Communication to the Isolated Channel Failed

POINT	BIT	DESCRIPTION
	9	Overrange Input/Blown Fuse/Open Loop
6	10	Communication to the Isolated Channel Failed
	11	Overrange Input/Blown Fuse/Open Loop
7	12	Communication to the Isolated Channel Failed
	13	Overrange Input/Blown Fuse/Open Loop
8	14	Communication to the Isolated Channel Failed
	15	Overrange Input/Blown Fuse/Open Loop

Communication to the Isolated Channel Failed - This bit is set when the communication to the corresponding isolated channel has failed.

Overrange Input/Blown Fuse/Open Loop – This bit is set as follows:

- Current Input (Group 1) – When an input current less than 2.5mA (a blown fuse or open loop condition) is detected, or an overrange (greater than 24.6mA) of full scale is present.
- Voltage Input (Group 2) – When an overrange input of ±121% of the full scale value is read.

5.6 DIAGNOSTIC LEDS

The following table lists the module's LEDs and describes what they mean when lit.

14-Bit Analog Input Diagnostic LEDs

LED	DESCRIPTION
P (Green)	Power OK LED. Lit when the +5V power is OK.
C (Green)	Communications OK LED. Lit when the Controller is communicating with the module.
I (Red)	Internal Error LED. Lit whenever there is any type of error with the module **except** for a loss of power. Possible causes are: ▪ Module initialization is in progress. ▪ I/O Bus timeout has occurred. ▪ Register, static RAM, or FLASH checksum error. ▪ Module reset ▪ Module is uncalibrated. ▪ Forced error has been received from the Controller. ▪ Communication between the Field and Logic boards failed.

LED	DESCRIPTION
CH1 - CH 8 (Red)	Channel error. Lit whenever there is an error associated with a channel or channels. Possible causes are: ▪ Positive overrange: Input voltage greater than +121% of full scale value (for modules configured as voltage input). ▪ Negative overrange: Input voltage less than -121% of full scale value (for modules configured as voltage input). ▪ Input current less than 2.5mA or blown fuse (for module configured as current input). ▪ An overrange (greater than 24.6mA) of full scale is present (for modules configured as current input). ▪ Self calibration readings out of range.

5.7 SPECIFICATIONS

Electronics Module (1C31224)

Personality Module (1C31227)

14-Bit Analog Input Module Specifications

DESCRIPTION	VALUE
Number of channels	8
Input range	4 - 20 mA [1] ±1V [2]
Resolution	Group 1:14 bits, Group 2:13 bits & Sign
Guaranteed accuracy (@25×C)	±0.10% of full scale value ±1/2LSB @99.7% confidence.
Temperature coefficient	±0.24% of the full scale value over 0 to 60×C.
Input impedance: [3]	10 MW
Sampling rate	20 times per second minimum when configured for 60 Hz rejection 25 times per second minimum when configured for 50Hz rejection
Self-calibration	On demand by the Ovation Controller.
Diagnostics	Internal module operating faults. Out of range detection. Open loop detection for current inputs.
Dielectric isolation: Channel to channel Channel to logic	 1000 V AC/DC 1000 V AC/DC
Normal mode rejection	60 dB @50 Hz ± 1/2% or @60 Hz ± 1/2% (when properly configured) 30 dB (typical) @50 Hz ± 5% or @60 Hz ± 5% (when properly configured)

DESCRIPTION	VALUE
Common mode rejection	120 dB @ DC or @ the nominal (50/60 Hz) line frequency ± 1/2% and harmonics. 100 dB (typical) for nominal line frequency ± 5% and harmonics.
Module power	Main: 2.4 W typical; 3.125 W maximum Aux: When used (1C31227G01) Aux power supply voltage = 24 V DC 3.84 W typical (8 inputs @ 20mA each)
Operating temperature range	0 to 60×C (32×F to 140×F)
Storage temperature range	-40×C to 85×C (-40×F to 185×F)
Humidity (non-condensing)	0 to 95%
[1] Current inputs when using Personality module 1C31224G01 with 1C31227G01 Electronics Module. [2] Voltage inputs when using Personality module 1C31224G02 with 1C31227G02 Electronics Module. [3] Only for the voltage input module (Personality module 1C31224G02 with 1C31227G02 Electronics Module).	

SECTION 6

ANALOG HIGH SPEED INPUT MODULE (14 BITS)

IN THIS SECTION

Description *67*
Module Group Information *67*
Module Specific Information *69*
Wiring Information *74*
Address Location Information *82*
Diagnostic LEDs *91*
Specifications *92*

6.1 DESCRIPTION

The combined Personality and Electronics Modules form the High Speed Analog Input Module. Eight sets of individually isolated input channels provide 14-bit resolution with 50 or 60 samples per second conversion rates. The input signals are conditioned and routed through the appropriate Personality Module to the Electronics Module. The Personality Module also provides surge protection to protect the input circuits of the Electronics Module. The Electronics Module performs the analog to digital conversions and provides interfacing to the Ovation Serial I/O Bus.

The 14 bit High Speed Analog Input is applicable for CE Mark certified systems.

Note: *I/O Module General Information (see page 15) contains information on for environmental, installation, wiring, and fuse information for I/O modules.*

6.2 MODULE GROUP INFORMATION

6.2.1 ELECTRONICS MODULE (EMOD)

There are four groups of Electronics modules for the High Speed Analog Input Module:

- **5X00070G01** interfaces to current signals with an input range of 4 to 20 mA.
- **5X00070G02** interfaces to voltage signals with an input range of ±1V, ±250mV, ±100mV.
- **5X00070G03** interfaces to voltage signals with an input range of ±5V, ±10V.
- **5X00070G04** interfaces to thermocouple inputs ± 20mV, ± 50Vm, ± 100mV.

6.2.2 PERSONALITY MODULE (PMOD)

There are five groups of Personality modules for the High Speed Analog Input Module:

- **1C31227G01** interfaces to current input with an input range of 4 - 20 mA.
- **1C31227G02** voltage input.
- **1C31116G02** field powered current input ± 1mA.
- **1C31116G03** local powered ± 1mA current only.
- **1C31116G04** voltage inputs to temperature sensor.

6.2.3 SUBSYSTEMS, ANALOG INPUT (14 BIT HIGH SPEED)

Analog Input Subsystems (14 bit High Speed)[1]

RANGE	CHANNELS	ELECTRONIC MODULE	PERSONALITY MODULE
4 - 20mA, Field or Locally powered	8	5X00070G01	1C31227G01
± 100mV, ± 250mV, ± 1V	8	5X00070G02	1C31227G02
± 5V, ± 10V	8	5X00070G03	1C31227G02
± 1mA 2 wire local powered	8	5X00070G02	1C31116G03
± 1mA 4wire field powered	8	5X00070G02	1C31116G02
± 20mV, ± 50mV, ± 100 (Thermocouple)	8	5X00070G04	1C31116G04

[1] All module configurations listed in the table are CE Mark Certified.

All Configurations CE Mark Certified

6.3 MODULE SPECIFIC INFORMATION

6.3.1 MODULE BLOCK DIAGRAM

The simplified block diagram for the voltage input configuration of the High Speed Analog Input module is shown in the following figure. The channel #1 input is grounded locally at the cabinet, and grounding at the field device is shown for the channel #8 input.

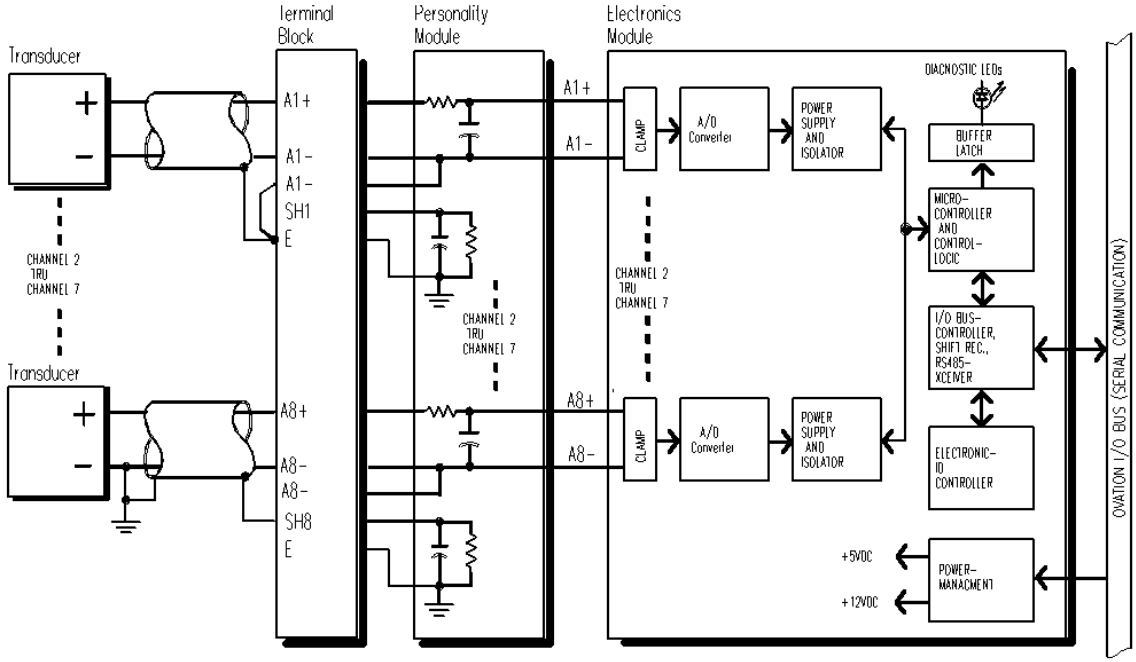


Figure 19: Voltage input Configuration using Pmod 1C31227G02

6.3.2 EXTERNAL POWER SUPPLIES

Note: *Module power specifications (main and auxiliary) refer to the actual power drawn by the module from the 24VDC main power supply and from the auxiliary power supply (if required) and* ***NOT*** *from the AC or DC Mains.*

If the High Speed Analog Input module uses the current input 1C31227G01 or 1C31116G03 Personality modules, the required voltage source may be obtained from the internal auxiliary power supply (backplane).

If it uses Pmod 1C31227G01 or 1C1116G02, field powered current loops can be used. Note that 1C31227G01 supplies both field and local power.

6.3.3 THERMOCOUPLE FUNCTION

When two dissimilar metals (a thermocouple) are joined together, a voltage (the Seebeck Voltage) is generated between them. This voltage is directly related to the temperature at the junction of the two metals. The relationship between the voltage and the temperature can be best described by a fifth order polynomial, determined by the two types of metals that are joined.

To measure the voltage (Vt) between the two metals, a voltmeter (in this case, an analog input card) must be connected to each wire. Unfortunately, this produces two new junctions and voltages (V1 and V2) between the terminals and the thermocouples. The following formula is used to find Vt: Vt = Vm -V1 -V2.

It is not possible to measure V1 and V2 without inducing more junctions and voltages; therefore, the analog input subsystem has a temperature sensor on the Personality module (1C31116G04) to measure the temperature (Tj) at the terminal block of the base unit.

A conversion formula, determined from the junction metal and thermocouple metals, is used to calculate the combined voltage of V1 and V2. This is called **Cold Junction Compensation**.

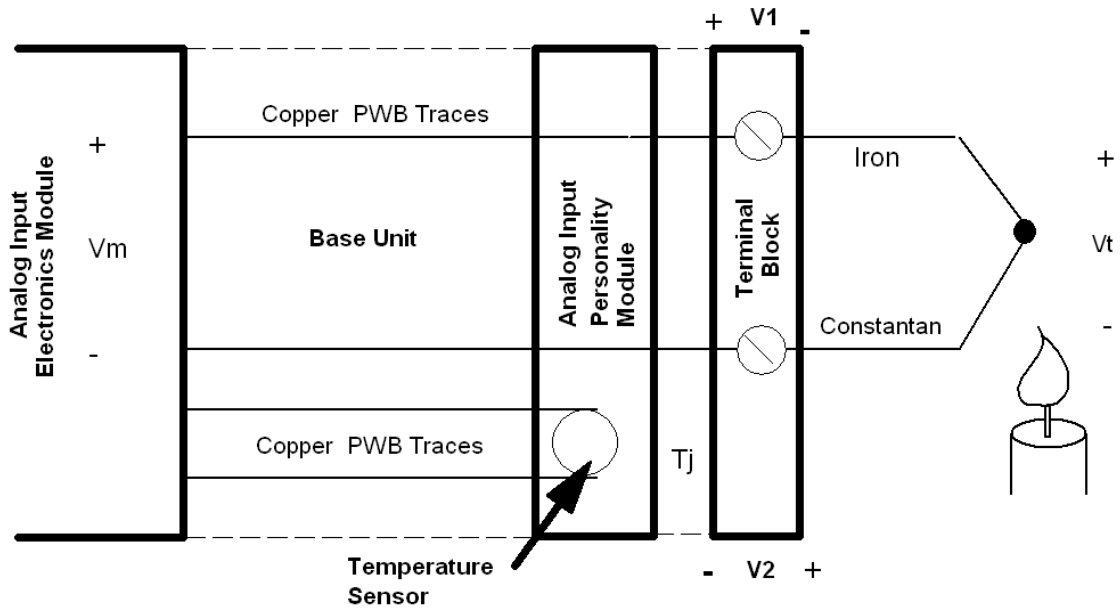


Figure 20: Thermocouple Illustration

Temperature Sensor Personality Module (1C31116G04)

Personality module 1C1116G04 of the analog input subsystem includes a temperature sensor IC. This is used for measuring the temperature of the terminal block to provide cold junction compensation for thermocouple inputs.

This module is used in conjunction with a terminal block cover (1C31207H01) to maintain a uniform temperature of the terminal block and sensor area. The cover fits over an entire base; however, the sensor only accurately measures the temperature under the half of the cover where the temperature sensor personality module is installed. Therefore, if both modules under the cover require cold junction compensation, they each require the temperature sensor personality module.

Note: *Installation instructions for the terminal block cover are provided in the Temperature Compensation Cover Mounting Kit (1B30047G01).*

The Group 4 Personality module provides a terminal block temperature measurement feature with the following specifications:

- Sampling Rate = 600 msec, maximum, 300 msec, typical
- Resolution = +/- 0.5×C (+/- 0.9 ×F)
- Accuracy = +/- 0.5×C over a 0×C to 70×C range

  (+/- 0.9 ×F over a 32×F to 158×F range)

(See *Ovation Record Type Reference Manual*, *Ovation Point Builder User Guide*, and *Ovation Developer Studio User Guide*.)

Assigning Thermocouple Coefficients

Use the Instrumentation tab of the Point Builder to select the Field Instrumentation Type (B or TB, E or TE, J or TJ, K or TK, R or TR, S or TS, T or TT). The Ovation system then assigns the default thermocouple coefficients based on the Type selected. Refer to the following table for these coefficient definitions.

If you override the default coefficients by entering new values, the new values remain **until** you select another thermocouple type. The values then return to the values for the type just selected.

Thermocouple Coefficient Definitions

Thermocouple Type	Standard Temperature Range	Actual range in MV / TEMP	Best Fit
B or TB	400 to 1100 Degrees C	0.000 to 13.814 (0 to 1820)	20 mv card
	800 to 2000 Degrees F	0.006 to 13.814 (0 to 3308)	20 mv card
Fahrenheit COEF_1 = 3.5164700E+02 COEF_2 = 6.1388490E+05 COEF_3 = – 1.5397740E+08 COEF_4 = 3.3593730E+10 COEF_5 = – 4.0518260E+12 COEF_6 = 2.0039330E+14 COEF_7 = – 2.0E-06 COEF_8 = 0.0		**Centigrade** COEF_1 = 1.7758167E+02 COEF_2 = 3.4104717E+05 COEF_3 = – 8.5543000E+07 COEF_4 = – 8.5543000E+07 COEF_5 = – 8.5543000E+07 COEF_6 = 1.1132961E+14 COEF_7 = – 2.0E-06 COEF_8 = 0.0	
E or TE	– 18 to 286 Degrees C 0 to 550 Degrees F	– 9.835 to 19.945 (– 270 to 286) – 9.835 to 19.945 (– 450 to 548)	20 mv card 20 mv card
	– 18 to 661 Degrees C 0 to 1200 Degrees F	– 9.835 to 49.992 (– 270 to 661) – 9.835 to 49.956 (– 450 to 1221)	50 mv card 50 mv card
	– 18 to 1000 Degrees C 0 to 1832 Degrees F	– 9.835 to 76.358 (– 270 to 1000) – 9.835 to 76.358 (– 450 to 1832)	100 mv card 100 mv card
Fahrenheit COEF_1 = 3.1672830E+01 COEF_2 = 3.0306280E+04 COEF_3 = – 3.3449490E+05 COEF_4 = 6.8495880E+06 COEF_5 = – 6.9753490E+07 COEF_6 = 2.9236530E0+08 COEF_7 = – 1.0939E-03 COEF_8 = 3.365E-05		**Centigrade** COEF_1 = – 1.8176111E-01 COEF_2 = 1.6836822E+04 COEF_3 = – 1.8583050E+05 COEF_4 = 3.8053267E+06 COEF_5 = – 3.8751939E+07 COEF_6 = 1.6242517E+08 COEF_7 = – 1.71E-05 COEF_8 = 6.057E-05	
J or TJ	– 18 to 365 Degrees C – 140 to 700 Degrees F – 18 to 760 Degrees C – 140 to 1400 Degrees F	– 8.096 to 19.971 (– 210 to 366) – 8.137 to 19.977 (– 350 to 691) – 8.096 to 42.922 (– 210 to 760) – 8.137 to 42.922 (– 350 to 1400)	20 mv card 20 mv card 50 mv card 50 mv card
Fahrenheit COEF_1 = 3.112531E+01 COEF_2 = 3.6070270E+04 COEF_3 = – 4.2886170E+05 COEF_4 = 2.2613820E+07 COEF_5 = – 5.1743790E+08 COEF_6 = 3.9727830E+09 COEF_7 = – 9.256E-04 COEF_8 = 2.862E-05		**Centigrade** COEF_1 = – 4.8593889E-01 COEF_2 = 2.0039039E+04 COEF_3 = – 2.3825650E+05 COEF_4 = 1.2563233E+07 COEF_5 = – 2.8746550E+08 COEF_6 = 2.2071017E+09 COEF_7 = – 9.76E-06 COEF_8 = 5.1516E-05	
K or TK	– 18 to 480 Degrees C 0 to 900 Degrees F	– 6.458 to 19.959 (– 270 to 484) – 6.456 to 19.978 (– 450 to 904)	20 mv card 20 mv card
	– 18 to 1230 Degrees C 0 to 2250 Degrees F	– 6.458 to 49.988 (– 270 to 1232) – 6.456 to 49.996 (– 450 to 2250)	50 mv card 50 mv card
	– 18 to 1370 Degrees C 0 to 2500 Degrees F	– 6.458 to 54.875 (– 270 to 1372) – 6.456 to 54.845 (– 450 to 2500)	100 mv card 100 mv card

Thermocouple Type	Standard Temperature Range	Actual range in MV / TEMP	Best Fit
Fahrenheit COEF_1 = 3.0344730E+01 COEF_2 = 4.4031910E+04 COEF_3 = 1.615839E+05 COEF_4 = – 1.616257E+07 COEF_5 = 4.4011090E+08 COEF_6 = – 3.599650E+09 COEF_7 = – 7.259E-04 COEF_8 = 2.243E-05		**Centigrade** COEF_1 = – 9.1959444E-01 COEF_2 = 2.4462172E+04 COEF_3 = 8.9768833E+04 COEF_4 = – 8.9792056E+06 COEF_5 = 2.4450606E+08 COEF_6 = – 1.9998056E+09 COEF_7 = – 8.14E-06 COEF_8 = 4.0374E-05	
R or TR	260 to 1100 Degrees C 500 to 2000 Degrees F	0.000 to 19.998 (0 to 1684) 0.089 to 19.997 (0 to 3063)	20 mv card 20 mv card
Fahrenheit COEF_1 = 8.3628480E+01 COEF_2 = 2.2737160E+05 COEF_3 = – 1.2482860E+07 COEF_4 = 1.2062540E+09 COEF_5 = – 7.4221280E+10 COEF_6 = 1.89930000E+12 COEF_7 = – 1.084E-04 COEF_8 = 3.24E-06		**Centigrade** COEF_1 = 2.8682489E+01 COEF_2 = 1.2631756E+05 COEF_3 = – 6.9349222E+06 COEF_4 = 6.7014111E+08 COEF_5 = – 4.1234044E+10 COEF_6 = 1.0551667E+12 COEF_7 = – 4.72E-06 COEF_8 = 5.832E-06	
S or TS	400 to 1100 Degrees C 750 to 2000 Degrees F	0.000 to 18.698 (0 to 1768) -0.092 to 18.696 (0 to 3214)	20 mv card 20 mv card
Fahrenheit COEF_1 = 1.1803440E+02 COEF_2 = 1.9859180E+05 COEF_3 = – 1.9730960E+04 COEF_4 = – 5.0093290E+08 COEF_5 = 4.1104880E+10 COEF_6 = – 1.1557940E+12 COEF_7 = – 1.0847E-04 COEF_8 = 3.26E-06		**Centigrade** COEF_1 = 4.7796889E+01 COEF_2 = 1.1032878E+05 COEF_3 = – 1.0961644E+04 COEF_4 = – 2.7829606E+08 COEF_5 = 2.2836044E+10 COEF_6 = – 6.4210778E+11 COEF_7 = – 4.15E-06 COEF_8 = 5.868E-06	
T or TT	-46 to 400 Degrees C -50 to 750 Degrees F	-6.258 to 19.945 (-270 to 385) -6.254 to 19.979 (-450 to 726)	20 mv card 20 mv card
Fahrenheit COEF_1 = 3.1892240E+01 COEF_2 = 4.6693280E+04 COEF_3 = – 1.3257390E+06 COEF_4 = 6.9620670E+07 COEF_5 = – 2.3278080E+09 COEF_6 = 3.3306460E+10 COEF_7 = – 7.3333E-04 COEF_8 = 2.243E-05		**Centigrade** COEF_1 = – 5.9866667E-02 COEF_2 = 2.5940711E+04 COEF_3 = – 7.3652167E+05 COEF_4 = 3.8678150E+07 COEF_5 = – 1.2932267E+09 COEF_6 = 1.8503589E+10 COEF_7 = – 1.55700E-05 COEF_8 = 4.0374E-05	

6.4 WIRING INFORMATION

6.4.1 HIGH SPEED ANALOG INPUT TERMINAL BLOCK WIRING INFORMATION - PMOD 1C31227

Each Personality module has a simplified wiring diagram label on its side, which appears above the terminal block. This diagram indicates how the wiring from the field is to be connected to the terminal block in the base unit.

The diagrams for the analog input Personality modules are illustrated in the field connections diagrams (see page 78). The following table lists and defines the abbreviations used in those diagrams.

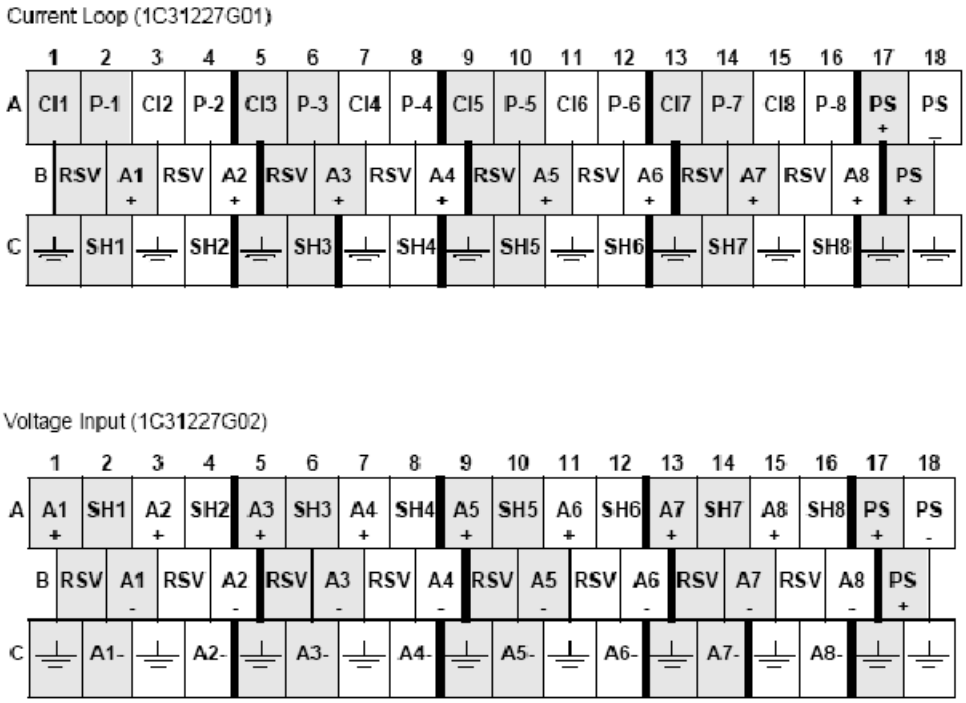
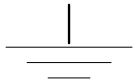

Current Loop (1C31227G01)
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18
A CI1 P-1 CI2 P-2 CI3 P-3 CI4 P-4 CI5 P-5 CI6 P-6 CI7 P-7 CI8 P-8 PS + PS -
B RSV A1 + RSV A2 + RSV A3 + RSV A4 + RSV A5 + RSV A6 + RSV A7 + RSV A8 + PS +
C SH1 SH2 SH3 SH4 SH5 SH6 SH7 SH8
Voltage Input (1C31227G02)
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18
A A1 + SH1 A2 + SH2 A3 + SH3 A4 + SH4 A5 + SH5 A6 + SH6 A7 + SH7 A8 + SH8 PS + PS -
B RSV A1 - RSV A2 - RSV A3 - RSV A4 - RSV A5 - RSV A6 - RSV A7 - RSV A8 - PS +
C A1- A2- A3- A4- A5- A6- A7- A8-

Figure 21: Terminal Block Connections for the Analog Input 1C31227 Pmods

Abbreviations Used in Diagrams

ABBREVIATION	DEFINITION
A1 - A8 +	Analog Input positive terminal connection (connected to the positive terminal of the field device).
A1 - A8 -	Analog Input negative terminal connection (voltage input group only).
P-1 - P-8	Loop power output terminals (for locally powered loops).
CI1 - CI8	Current input terminals.
SH1 - SH8	Shield terminal connection.

ABBREVIATION	DEFINITION
RSV	Reserved terminal. No connections allowed on these terminals.
	Earth ground terminals.
PS+, PS-	Auxiliary power supply terminals.

Use shielded twisted pair wire for the field wiring. Tie the Analog Input negative terminal and shield together and to earth ground, either locally at the cabinet or at the field device. Voltage inputs use the 1C31227G02 Personality Modules. Grounding the shield and the analog input negative terminal at the cabinet or at the field device is arranged by the proper Terminal Block connections.

Similarly, current inputs using the 1C31227G01 Personality Modules can accommodate field or locally powered devices by using the correct terminal block connections.

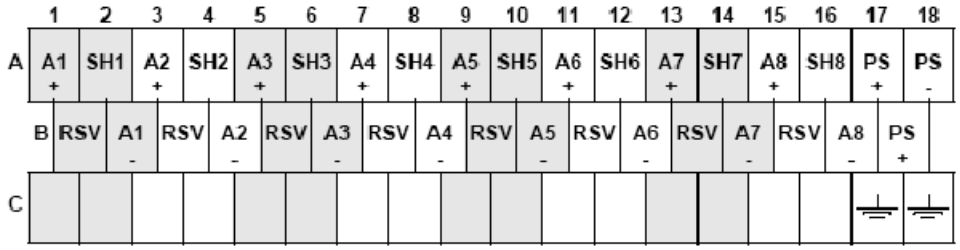
The Personality Modules have a field connection diagram label on top of each module to facilitate field wiring. The following figures show the implementations of the field connections for the various Personality Module and field device combinations.

6.4.2 HIGH SPEED ANALOG INPUT TERMINAL BLOCK WIRING INFORMATION - PMOD 1C31116

Each Personality module has a simplified wiring diagram label on its side, which appears above the terminal block. This diagram indicates how the wiring from the field is to be connected to the terminal block in the base unit.

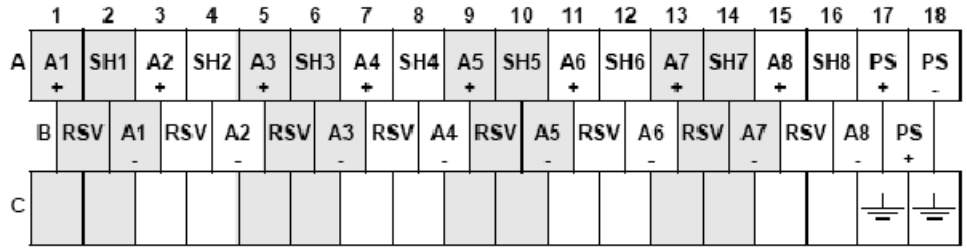
The diagrams for the analog input Personality modules are illustrated in the following figure. The following table lists and defines the abbreviations used in those diagrams.

Thermocouple Input: (1C31116G04)


1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18
A A1 + SH1 A2 + SH2 A3 + SH3 A4 + SH4 A5 + SH5 A6 + SH6 A7 + SH7 A8 + SH8 PS + PS -
B RSV A1 - RSV A2 - RSV A3 - RSV A4 - RSV A5 - RSV A6 - RSV A7 - RSV A8 - PS +
C

Note: Internal jumpers are in this personality module for locally grounding the shield and (-) connections to earth ground.

Field Powered Current Loop: (1C31116G02)


1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18
A A1 + SH1 A2 + SH2 A3 + SH3 A4 + SH4 A5 + SH5 A6 + SH6 A7 + SH7 A8 + SH8 PS + PS -
B RSV A1 - RSV A2 - RSV A3 - RSV A4 - RSV A5 - RSV A6 - RSV A7 - RSV A8 - PS +
C

Locally Powered Current Loop: (1C31116G03)

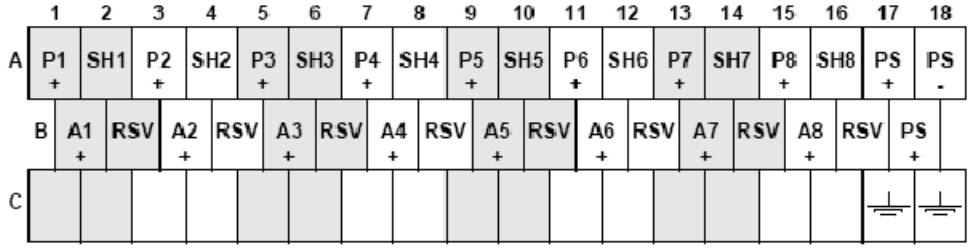
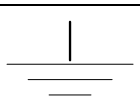

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18
A P1 + SH1 P2 + SH2 P3 + SH3 P4 + SH4 P5 + SH5 P6 + SH6 P7 + SH7 P8 + SH8 PS + PS -
B A1 + RSV A2 + RSV A3 + RSV A4 + RSV A5 + RSV A6 + RSV A7 + RSV A8 + RSV PS +
C

Figure 22: Terminal Block Connections for the Analog Input 1C31116 Pmods

Terminal Block Connections for the Analog Input 1C31116 Pmods

Abbreviations Used in Diagrams

ABBREVIATION	DEFINITION
A1 - A8 +	Analog Input positive terminal connection.
A1 - A8 -	Analog Input negative terminal connection.
	Earth ground terminals.
P1 - P8 +	Positive terminal connection for current loop power.
PS+, PS-	Auxiliary power supply terminals.
RSV	Reserved terminal. No connections allowed on these terminals.
SH1 - SH8	Shield terminal connection (for non-CE Mark certified systems).

Note: *Do **not** use unmarked terminal block locations.*

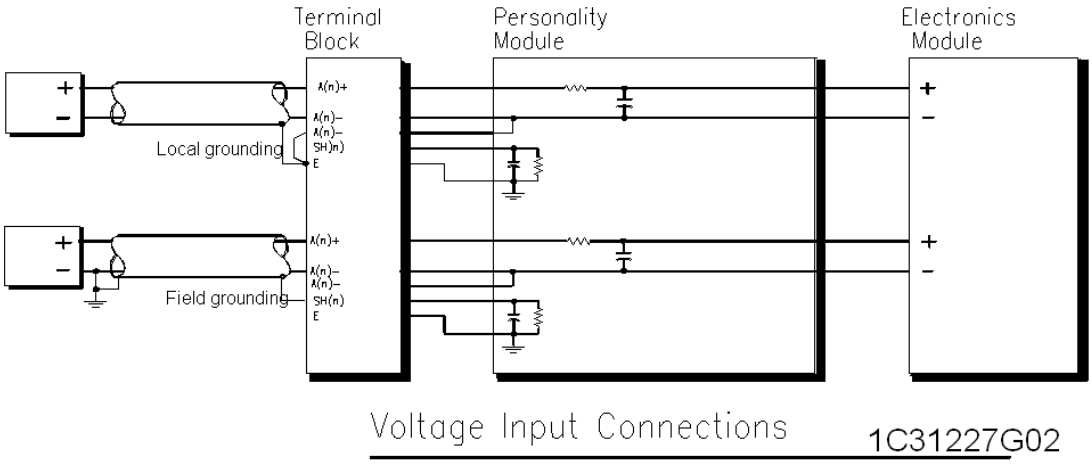
*Shield terminals (SH) are **not** connected in CE Mark systems.*

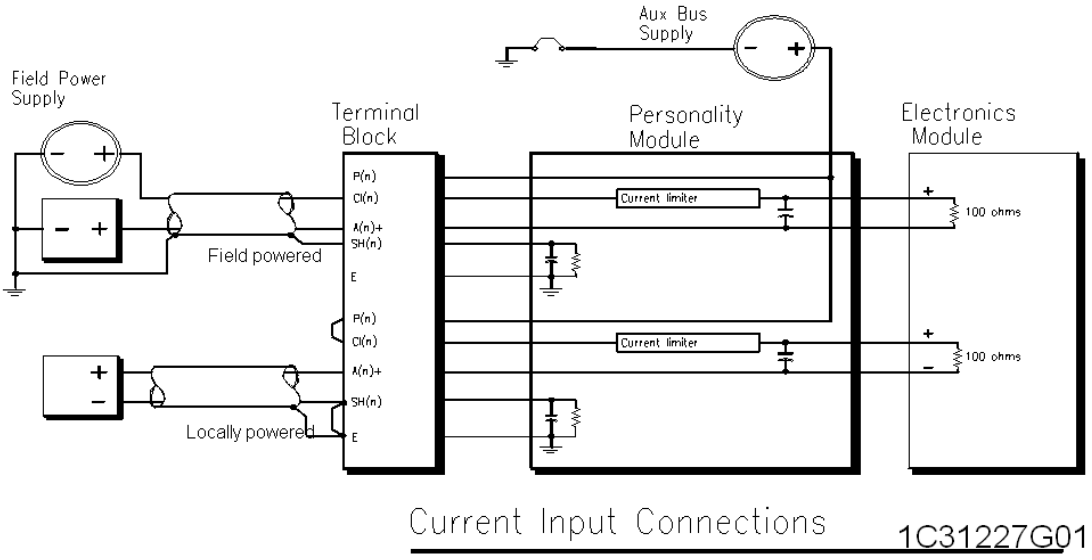
6.4.3 HIGH SPEED ANALOG INPUT FIELD CONNECTION WIRING DIAGRAMS

As is standard for analog signals, shielded twisted-pair wire should be used for the field interface. For the analog input, the negative (-) and shield should be tied together and to earth ground, either locally at the cabinet or at the field device.

The following four figures show how the various Personality modules require these connections or how the options are implemented. The fifth drawing illustrates the jumper settings for the Personality module.

6.4.4 NON-CE MARK SYSTEMS



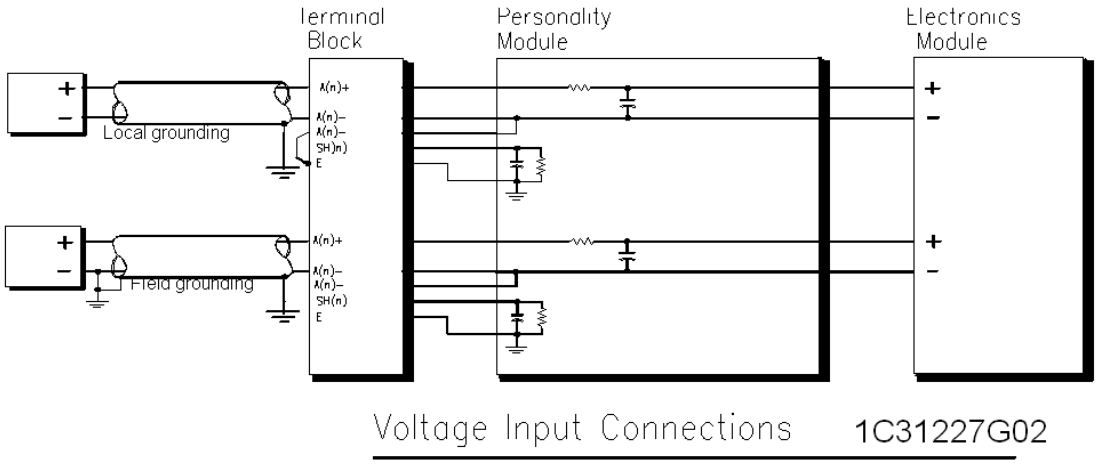


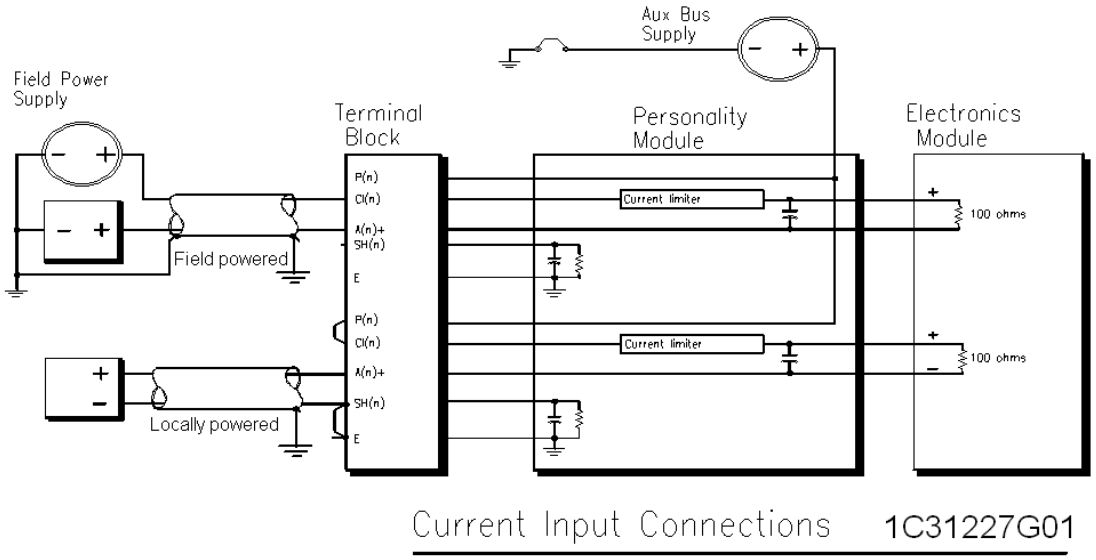
Caution

When using locally powered current inputs, the power distribution panel MUST be equipped with jumper module 5A26471G01 to ensure proper grounding of the aux Bus supply.

Figure 23: Field Connections for the Input Connectors (Non-CE Mark)

6.4.5 CE MARK SYSTEMS





Caution

When using locally powered current inputs, the power distribution panel MUST be equipped with jumper module 5A26471G01 to ensure proper grounding of the aux Bus supply.

All field wiring must be braid shielded and grounded at the entry point of the cabinet using recommended hardware (refer to "Cable Guidelines" in the applicable Ovation installation manual for your system).

Figure 24: Field Connections for the Input Connectors (CE Mark)

6.4.6 NON-CE MARK CERTIFIED SYSTEMS

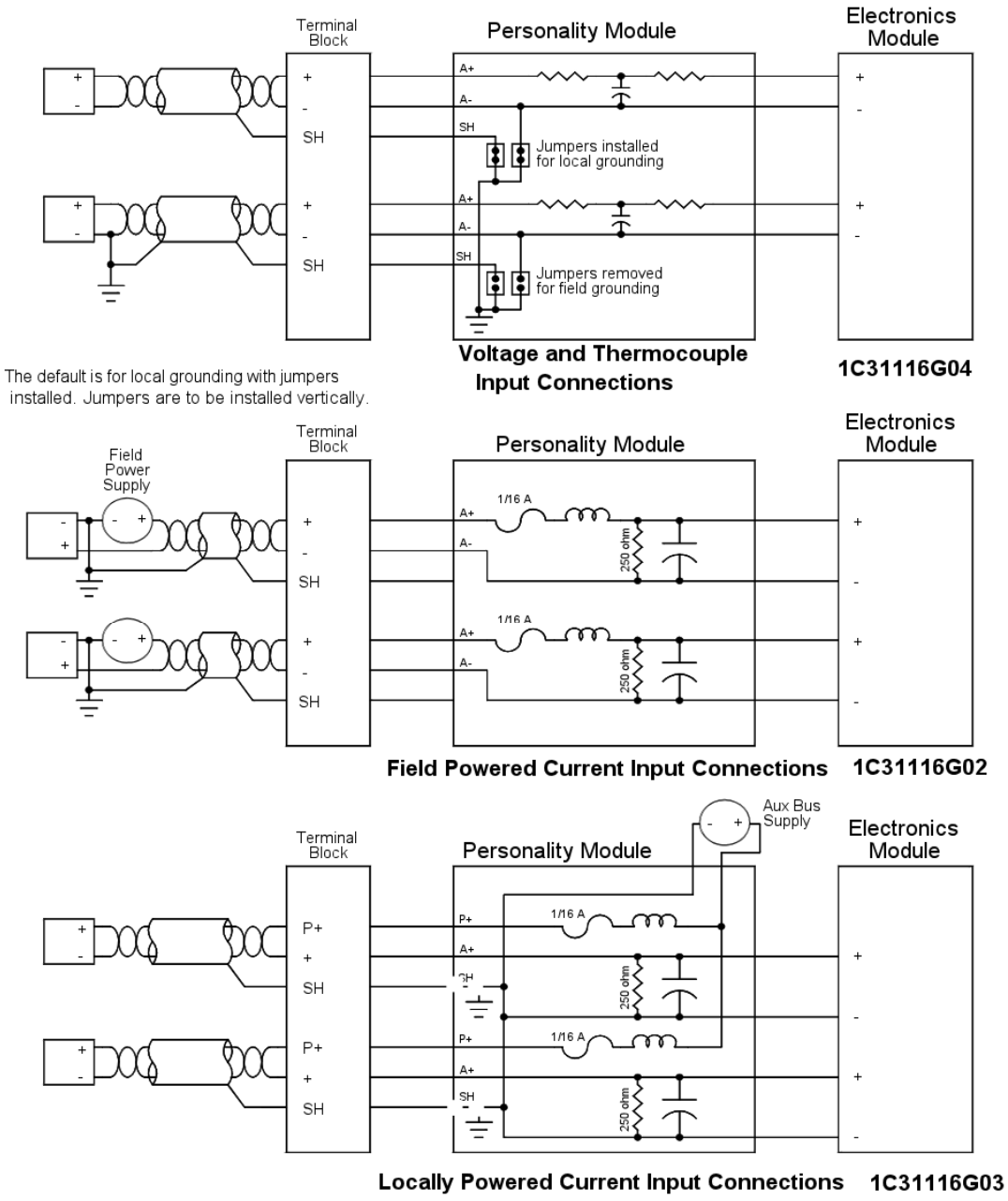
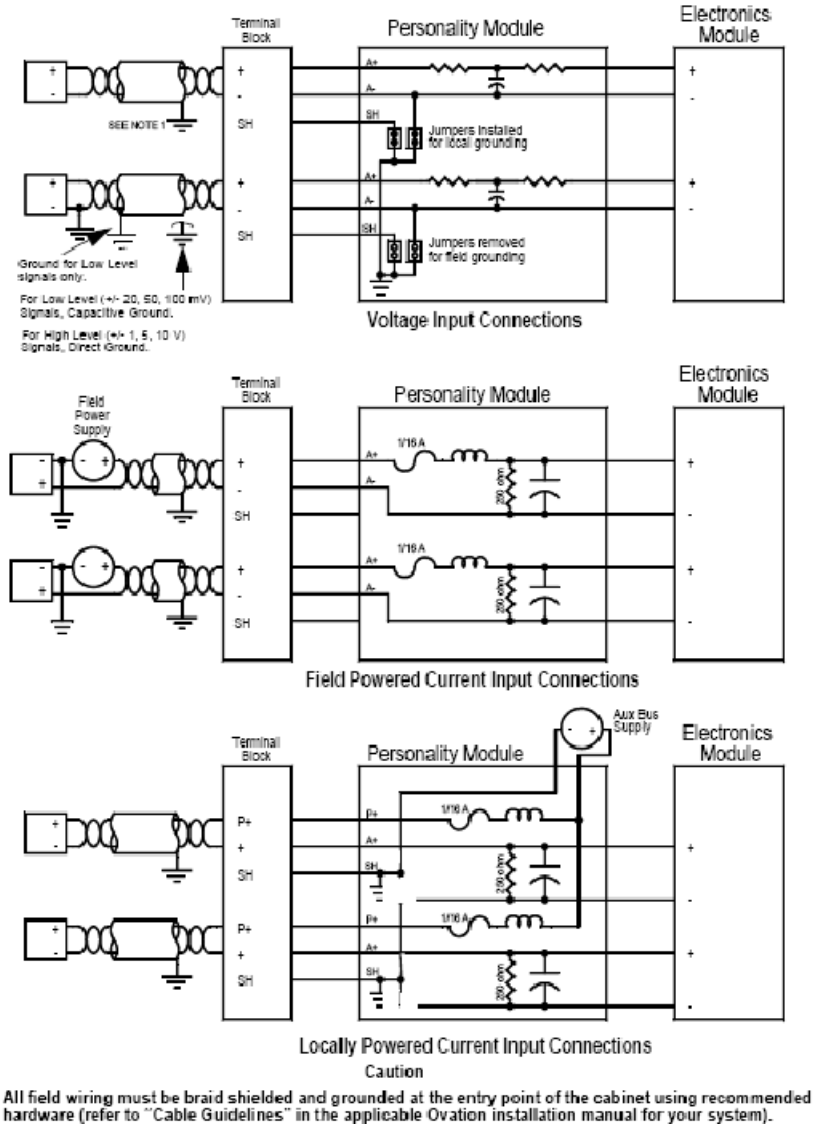


Figure 25: Field Connections for the Analog Input Pmod (Non-CE Mark)

6.4.7 CE MARK CERTIFIED SYSTEMS


Terminal Block
Personality Module
Electronics Module
SEE NOTE 1
Jumpers installed for local grounding
Jumpers removed for field grounding
Ground for Low Level signals only.
For Low Level (+/- 20, 50, 100 mV) Signals, Capacitive Ground.
For High Level (+/- 1, 5, 10 V) Signals, Direct Ground.
Voltage Input Connections
Field Power Supply
1/16 A
Field Powered Current Input Connections
Aux Bus Supply
Locally Powered Current Input Connections

Caution

All field wiring must be braid shielded and grounded at the entry point of the cabinet using recommended hardware (refer to "Cable Guidelines" in the applicable Ovation installation manual for your system).

Figure 26: Field Connections for the Analog Input Personality Module (CE Mark)

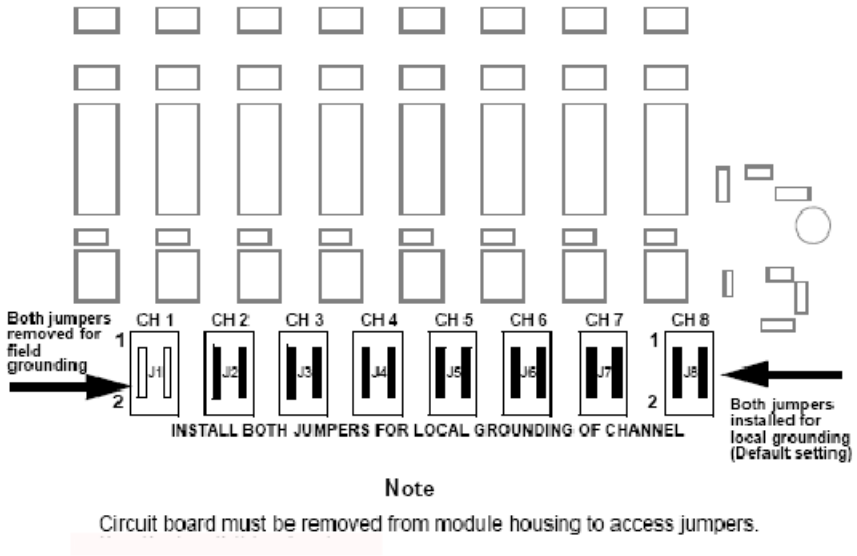


Figure 27: Jumper Settings for Analog Input Personality Module (1C31116G04)

6.5 Address Location Information

6.5.1 High Speed Analog Input Address Locations (Group 1)

Word address 13 (D in Hex) is used to configure the module and provide status information to the Controller. It varies slightly with the different groups (1-4), primarily in module calibration and range selection. The bit information contained within these words is shown in the following table.

These status words are only updated once per input channel sampling period; therefore, any Controller action based on changing the configuration (writing to address 13) must take this delay into account.

Data Format for the Configuration / Module Status Register for Group 1
Definitions for the Configuration/Module Status Register Lists

Bit	Description - Configuration Register (Write)	Description - Module Status Register (Read)
0	Configure Module	Module Configured (1 = configured)
1	Force Error	Internal or forced error (1 = forced error)
2	0, (ADD4 bit During Diagnostics)	(Not Used)
3	0, (ADD5 bit During Diagnostics)	(Not Used)
4	0, (ADD6 bit During Diagnostics)	Warming
5	0, (ADD7 bit During Diagnostics)	(Not Used)
6	0, (ADD8 bit During Diagnostics)	(Not Used)
7	0, (DIAG_SET, Initiates Diagnostics)	Module is Not Calibrated

8	50/60 Hz Selection (1 = 50Hz)	50 Hz/60 Hz System (1 = 50Hz)
9	Not Defined	(Not Used)
10	0, (Initiates system calibration during Diagnostics)	SYS_CAL In Progress (During Diagnostics)
11	SELF_CAL (Initiates Self Calibration)	SYS_CAL Completed (During Diagnostics)
12	Not Defined	SYS_CAL Failed (During Diagnostics)
13	Not Defined	Internal Memory Error
14	Not Defined	Module In Diagnostic Mode (During Diagnostics)
15	Not Defined	Point Fault [1]
[1] Refer to the Point Quality Register for the descriptions of the Point Faults.		

Bits defined for Diagnostics are only used during factory testing.

The bit definitions for this register are encoded as shown in the above table and described below:

Bit 0: This bit configures the module (write) or indicates the configuration state of the module (read). A “1” indicates that the module is configured. Note that until the module is configured, reading from addresses 0 through 11 (B in Hex) produces an attention status.

Bit 1: This bit (write “1”) forces the module into the error state, resulting in the error LED being lit. The read of bit “1” indicates that there is an internal module error, or the Controller has forced the module into the error state. The state of this bit is always reflected by the module’s Internal Error LED. Whenever this bit is set, an attention status is returned to the Controller when addresses 0 through 11 (B in Hex) are read.

Bits 2-3: These bits are not used and are read as “0” under normal operation.

Bit 4: This bit (read) indicates that the module is in the Warming state. This state exists after power up and terminates after 8.16 seconds. The module is in the error condition during the warm up period.

Bits 5-6: These bits are not used and read as “0” under normal operation.

Bit 7: This bit (read) is the result of a checksum test of the EEPROM. A failure of this test can indicate a bad EEPROM, but it typically indicates that the module has not been calibrated. A “0” indicates that there is no error condition. If an error is present, the module error LED is lit. The point fault bit is also set since all the point data is not calibrated. The “1” state of this bit indicates an unrecoverable error condition in the field.

Bit 8: The status of this bit (read) indicates the conversion rate of the module; write to this bit configures the conversion rate of A/D converters as shown in the following table.

Conversion Rate (1/sec.)	Bit 8
60 (for 60Hz systems)	0
50 (for 50Hz systems)	1

Bit 9: This bit is not used and is read as “0” under normal operation.

Bit 10: This bit is not used and is read as “0” under normal operation.

Bit 11: This bit (write) is used to initiate self-calibration. The sampling rate during self-calibration is two per second. The status (read) bit is not used and is read as “0” under normal operation

Bit 12: This bit is not used and is read as “0” under normal operation.

Bit 13: This bit (read) indicates that the module has internal memory error (FLASH checksum, Register or Static RAM error). If this error is present, the module error LED is lit, the point fault bit is also set since the condition of the module is undetermined.

Bit 14: This bit is not used and is read as “0” under normal operation.

Bit 15: This bit indicates the point fault status of the module. It is the logical “OR” of the eight individual point-quality status bits, plus the bits 1, 4, 7, and 13 of this register. A “0” indicates that all eight points have good quality and no module error exists. When bits 1, 4, 7 or 13 of the Status Register are not set, this bit (when set to “1”) indicates that at least one of the points has bad quality. A subsequent read of the Point Quality Register (Address 12, C in Hex) reveals the point(s) that have bad quality. The Address 12 (C in Hex) Point Quality Register contains data only when the module fault is due to a bad point quality.

6.5.2 HIGH SPEED ANALOG INPUT ADDRESS LOCATIONS (GROUP 2)

Word address 13 (D in Hex) is used to configure the module and provide status information to the Controller. It varies slightly with the different groups (1-4), primarily in module calibration and range selection. The bit information contained within these words is shown in the following table.

These status words are only updated once per input channel sampling period; therefore, any Controller action based on changing the configuration (writing to address 13) must take this delay into account.

Data Format For the Configuration / Module Status Register for Group 2
Definitions for the Configuration/Module Status Register bits

BIT	DESCRIPTION - CONFIGURATION REGISTER (WRITE)	DESCRIPTION - MODULE STATUS REGISTER (READ)
0	Configure Module	Module Configured (1 = configured)
1	Force Error	Internal or forced error (1 = forced error)
2	0, (ADD4 bit During Diagnostics)	SYS_CAL In Progress (During Diagnostics)
3	0, (ADD5 bit During Diagnostics)	Module In Diagnostic Mode (During Diagnostics)
4	0, (ADD6 bit During Diagnostics)	Warming
5	0, (ADD7 bit During Diagnostics)	(Not Used)
6	0, (ADD8 bit During Diagnostics)	(Not Used)
7	0, (DIAG_SET, Initiates Diagnostics)	Module is Not Calibrated
8	50/60 Hz Selection (1 = 50Hz)	50 Hz/60 Hz System (1 = 50Hz)
9	250mv select (14 bit)/Not Defined (13 bit)	250mv select (14 bit)/ 0 (13 bit)
10	100mv select (14 bit)/Not Defined(13 bit)	100mv select(14 bit)/0 (13 bit)
11	SELF_CAL (Initiates Self Calibration)	SYS_CAL Completed (During Diagnostics)

12	0, (Initiates system calibration during Diagnostics)	SYS_CAL Failed (During Diagnostics)
13	0, Lock Calibration Gain (concurrent with the initiation of calibration during diagnostics)	Internal Memory Error
14	0, Clear Calibration (concurrent with the initiation of calibration during diagnostics)	(Not Used)[1]
15	Not Defined	Point Fault [1]
[1] Refer to the Point Quality Register for the descriptions of the Point Faults		

Bits defined for Diagnostics are only used during factory testing.

The bit definitions for this register are encoded as shown in the above table and described below:

Bit 0: This bit configures the module (write) or indicates the configuration state of the module (read). A “1” indicates that the module is configured. Note that until the module is configured, reading from addresses 0 through 11 (B in Hex) produces an attention status.

Bit 1: This bit (write “1”) forces the module into the error state, resulting in the error LED being lit. The read of bit “1” indicates that there is an internal module error, or the Controller has forced the module into the error state. The state of this bit is always reflected by the module’s Internal Error LED. Whenever this bit is set, an attention status is returned to the Controller when addresses 0 through 11 (B in Hex) are read.

Bits 2-3: These bits are not used and are read as “0” under normal operation.

Bit 4: This bit (read) indicates that the module is in the Warming state. This state exists after power up and terminates after 8.16 seconds. The module is in the error condition during the warm up period.

Bits 5-6: These bits are not used and are read as “0” under normal operation.

Bit 7: This bit (read) is the result of a checksum test of the EEPROM. A failure of this test can indicate a bad EEPROM, but it typically indicates that the module has not been calibrated. A “0” indicates that there is no error condition. If an error is present, the module error LED is lit. The point fault bit is also set since all the point data is not calibrated. The “1” state of this bit indicates an unrecoverable error condition in the field.

Bit 8: The status of this bit (read) indicates the conversion rate of the module, write to this bit configures the conversion rate of A/D converters as shown in the following table.

Conversion Rate (1/sec.)	Bit 8
60 (for 60Hz systems)	0
50 (for 50Hz systems)	1

Bits 9-10: These bits are used to configure the ranges.

Full Scale	Bit 9	Bit 10
1V	0	0
250 mv	1	0
100 mv	0	1
invalid	1	1

Bit 11: This bit (write) is used to initiate self-calibration. The sampling rate during self-calibration is two per second. The status (read) bit is not used and is read as “0” under normal operation.

Bit 12: This bit is not used and is read as “0” under normal operation.

Bit 13: This bit (read) indicates that the module has internal memory error (FLASH checksum, Register or Static RAM error). If this error is present, the module error LED is lit, the point fault bit is also set since the condition of the module is undetermined.

Bit 14: This bit is not used and is read as “0” under normal operation.

Bit 15: This bit indicates the point fault status of the module. It is the logical “OR” of the eight individual point-quality status bits, plus the bits 1, 4, 7, and 13 of this register. A “0” indicates that all eight points have good quality and no module error exists. When bits 1, 4, 7 or 13 of the Status Register are not set, this bit (when set to “1”) indicates that at least one of the points has bad quality. A subsequent read of the Point Quality Register (Address 12, C in Hex) reveals the point(s) that have bad quality. The Address 12 (C in Hex) Point Quality Register contains data only when the module fault is due to a bad point quality.

6.5.3 HIGH SPEED ANALOG INPUT ADDRESS LOCATIONS (GROUP 3)

Word address 13 (D in Hex) is used to configure the module and provide status information to the Controller. It varies slightly with the different groups (1-4), primarily in module calibration and range selection. The bit information contained within these words is shown in the following table.

These status words are only updated once per input channel sampling period; therefore, any Controller action based on changing the configuration (writing to address 13) must take this delay into account.

Data Format for the Configuration / Module Status Register for Group 3
Definitions for the Configuration/Module Status Register Bits

BIT	DESCRIPTION - CONFIGURATION REGISTER (WRITE)	DESCRIPTION - MODULE STATUS REGISTER (READ)
0	Configure Module	Module Configured (1 = configured)
1	Force Error	Internal or forced error (1 = forced error)
2	0, (ADD4 bit During Diagnostics)	SYS_CAL In Progress (During Diagnostics)
3	0, (ADD5 bit During Diagnostics)	Module In Diagnostic Mode (During Diagnostics)
4	0, (ADD6 bit During Diagnostics)	Warming
5	0, (ADD7 bit During Diagnostics)	(Not Used)
6	0, (ADD8 bit During Diagnostics)	(Not Used)
7	0, (DIAG_SET, Initiates Diagnostics)	Module is Not Calibrated
8	50/60 Hz Selection (1 = 50Hz)	50 Hz/60 Hz System (1 = 50Hz)
9	5V select (14 bit)/Don’t care (13 bit)	250mv select (14 bit)/ 0 (13 bit)
10	0 (14 bit)/Don’t care(13 bit)	100mv select(14 bit)/0 (13 bit)
11	SELF_CAL (Initiates Self Calibration)	SYS_CAL Completed (During Diagnostics

12	0, (Initiates system calibration during Diagnostics)	SYS_CAL Failed (During Diagnostics)
13	0, Lock Calibration Gain (concurrent with the initiation of calibration during diagnostics)	Internal Memory Error
14	0, Clear Calibration (concurrent with the initiation of calibration during diagnostics)	(Not Used)
15	Not Defined	Point Fault [1]
[1] Refer to the Point Quality Register for the descriptions of the Point Faults.		

Bits defined for Diagnostics are only used during factory testing.

The bit definitions for this register are encoded as shown in the above table and described below:

Bit 0: This bit configures the module (write) or indicates the configuration state of the module (read). A “1” indicates that the module is configured. Note that until the module is configured, reading from addresses 0 through 11 (B in Hex) produces an attention status.

Bit 1: This bit (write “1”) forces the module into the error state, resulting in the error LED being lit. The read of bit “1” indicates that there is an internal module error, or the Controller has forced the module into the error state. The state of this bit is always reflected by the module’s Internal Error LED. Whenever this bit is set, an attention status is returned to the Controller when addresses 0 through 11 (B in Hex) are read.

Bits 2-3: These bits are not used and are read as “0” under normal operation.

Bit 4: This bit (read) indicates that the module is in the Warming state. This state exists after power up and terminates after 8.16 seconds. The module is in the error condition during the warm up period.

Bits 5-6: These bits are not used and are read as “0” under normal operation.

Bit 7: This bit (read) is the result of a checksum test of the EEPROM. A failure of this test can indicate a bad EEPROM, but it typically indicates that the module has not been calibrated. A “0” indicates that there is no error condition. If an error is present, the module error LED is lit. The point fault bit is also set since all the point data is not calibrated. The “1” state of this bit indicates an unrecoverable error condition in the field.

Bit 8: The status of this bit (read) indicates the conversion rate of the module, write to this bit configures the conversion rate of A/D converters as shown in the following table.

Conversion Rate (1/sec.)	Bit 8
60 (for 60Hz systems)	0
50 (for 50Hz systems)	1

Bits 9-10: These bits are used to configure the ranges as follows for 14 bit operation. For 13 bit operation, these bits have no meaning.

Full Scale	Bit 9	Bit 10
10V	0	0
5V	1	0
2.5V(not supported)	0	1

invalid	1	1

Bit 11: This bit (write) is used to initiate self-calibration. The sampling rate during self-calibration is two per second. The status (read) bit is not used and read as “0” under normal operation.

Bit 12: This bit is not used and is read as “0” under normal operation.

Bit 13: This bit (read) indicates that the module has internal memory error (FLASH checksum, Register or Static RAM error). If this error is present, the module error LED is lit, the point fault bit is also set as the condition of the module is undetermined.

Bit 14: This bit is not used and is read as “0” under normal operation.

Bit 15: This bit indicates the point fault status of the module. It is the logical “OR” of the eight individual point-quality status bits, plus the bits 1, 4, 7, and 13 of this register. A “0” indicates that all eight points have good quality and no module error exists. When bits 1, 4, 7 or 13 of the Status Register are not set, this bit (when set to “1”) indicates that at least one of the points has bad quality. A subsequent read of the Point Quality Register (Address 12, C in Hex) reveals the point(s) that have bad quality. The Address 12 (C in Hex) Point Quality Register contains data only when the module fault is due to a bad point quality.

6.5.4 HIGH SPEED ANALOG INPUT ADDRESS LOCATIONS (GROUP 4)

Word address 13 (D in Hex) is used to configure the module and provide status information to the Controller. It varies slightly with the different groups (1-4), primarily in module calibration and range selection. The bit information contained within these words is shown in the following tables.

These status words are only updated once per input channel sampling period; therefore, any Controller action based on changing the configuration (writing to address 13) must take this delay into account.

Data Format for the Configuration / Module Status Register for Group 4
Definitions for the Configuration/Module Status Register Bits

BIT	DESCRIPTION - CONFIGURATION REGISTER (WRITE)	DESCRIPTION - MODULE STATUS REGISTER (READ)
0	Configure Module	Module Configured (1 = configured)
1	Force Error	Internal or forced error (1 = forced error)
2	0, (ADD4 bit During Diagnostics)	SYS_CAL In Progress (During Diagnostics)
3	0, (ADD5 bit During Diagnostics)	Module In Diagnostic Mode (During Diagnostics)
4	0, (ADD6 bit During Diagnostics)	Warming
5	0, (ADD7 bit During Diagnostics)	(Not Used)
6	0, (ADD8 bit During Diagnostics)	(Not Used)
7	0, (DIAG_SET, Initiates Diagnostics)	Module is Not Calibrated
8	50/60 Hz Selection (1 = 50Hz)	50 Hz/60 Hz System (1 = 50Hz)
9	50mv select (14 bit)/Don’t care (13 bit)	50mv select (14 bit)/ 0 (13 bit)
10	100mv select (14 bit)/Don’t care(13 bit)	100mv select (14 bit)/0 (13 bit)

11	SELF_CAL (Initiates Self Calibration)	SYS_CAL Completed (During Diagnostics)
12	0, (Initiates system calibration during Diagnostics)	SYS_CAL Failed (During Diagnostics)
13	0, Lock Calibration Gain (concurrent with the initiation of calibration during diagnostics)	Internal Memory Error
14	0, Clear Calibration (concurrent with the initiation of calibration during diagnostics)	Temperature Sensor Failure
15	Not Defined	Point Fault [1]
[1] Refer to the Point Quality Register for the descriptions of the Point Faults		

Bits defined for Diagnostics are only used during factory testing.

The bit definitions for this register are encoded as shown in the above table and described below:

Bit 0: This bit configures the module (write) or indicates the configuration state of the module (read). A “1” indicates that the module is configured. Note that until the module is configured, reading from addresses 0 through 11 (B in Hex) will produce an attention status.

Bit 1: This bit (write “1”) forces the module into the error state, resulting in the error LED being lit. The read of bit “1” indicates that there is an internal module error, or the Controller has forced the module into the error state. The state of this bit is always reflected by the module’s Internal Error LED. Whenever this bit is set, an attention status is returned to the Controller when addresses 0 through 11 (B in Hex) are read.

Bits 2-3: These bits are not used and are read as “0” under normal operation.

Bit 4: This bit (read) indicates that the module is in the “Warming” state. This state exists after power up and terminates after 8.16 seconds. The module will be in the error condition during the warm up period.

Bits 5-6: These bits are not used and are read as “0” under normal operation.

Bit 7: This bit (read) is the result of a checksum test of the EEPROM. A failure of this test can indicate a bad EEPROM, but it typically indicates that the module has not been calibrated. A “0” indicates that there is no error condition. If an error is present, the module error LED is lit. The point fault bit will also be set as all the point data is not calibrated. The “1” state of this bit indicates an unrecoverable error condition in the field.

Bit 8: The status of this bit (read) indicates the conversion rate of the input module, write to this bit configures the conversion rate of A/D converters as shown in the following table.

Conversion Rate (1/sec.)	Bit 8
60 (for 60Hz systems)	0
50 (for 50Hz systems)	1

Bits 9-10: These bits are used to configure the ranges as follows

Full Scale	Bit 9	Bit 10
20 mv	0	0
50 mv	1	0
100 mv	0	1

invalid	1	1

Bit 11: This bit (write) is used to initiate self-calibration. The sampling rate during self-calibration will be 2 per second. The status (read) bit is not used and is read as “0” under normal operation

Bit 12: This bit is not used and is read as “0” under normal operation.

Bit 13: This bit (read) indicates that the module has internal memory error (FLASH checksum, Register or Static RAM error). If this error is present, the module error LED is lit, the point fault bit will also be set as the condition of the module is undetermined.

Bit 14: This bit, if set, indicates that the temperature sensor has failed.

Bit 15: This bit indicates the point fault status of the module. It is the logical “OR” of the eight individual point-quality status bits, plus the bits 1, 4, 7, and 13 of this register. A “0” indicates that all eight points have good quality and no module error exists. When bits 1, 4, 7 or 13 of the Status Register are not set, this bit (when set to “1”) indicates that at least one of the points has bad quality. A subsequent read of the Point Quality Register (Address 12, C in Hex) will reveal the point(s) that have bad quality. The Address 12 (C in Hex) Point Quality Register contains data only when the module fault is due to a bad point quality.

Configuration and Status Register

Word address 14 (E in Hex) is not used and is read as “0” under normal operation.

Word address 12 (C in Hex) serves the purpose of reporting the point quality of the eight channel inputs.

Analog HS Input Point Quality Register (Address 12 or C in Hex)

POINT	BIT	DESCRIPTION
1	0	Communication to the Isolated Channel Failed
	1	Overrange Input/Blown Fuse/Open Loop
2	2	Communication to the Isolated Channel Failed
	3	Overrange Input/Blown Fuse/Open Loop
3	4	Communication to the Isolated Channel Failed
	5	Overrange Input/Blown Fuse/Open Loop
4	6	Communication to the Isolated Channel Failed
	7	Overrange Input/Blown Fuse/Open Loop
5	8	Communication to the Isolated Channel Failed
	9	Overrange Input/Blown Fuse/Open Loop
6	10	Communication to the Isolated Channel Failed
	11	Overrange Input/Blown Fuse/Open Loop
7	12	Communication to the Isolated Channel Failed
	13	Overrange Input/Blown Fuse/Open Loop

8	14	Communication to the Isolated Channel Failed
	15	Overrange Input/Blown Fuse/Open Loop

Communication to the Isolated Channel Failed - This bit is set when the communication to the corresponding isolated channel has failed.

Over-range Input/Blown Fuse/Open Loop – This bit is set as follows:

- **Current Input Emods** – When an input current less than 2.5mA (a blown fuse or open loop condition) is detected, or an overrange (greater than 24.6mA) of full scale is present.
- **Voltage Input Emods** – When an overrange input of ±121% of the full scale value is read.

6.6 DIAGNOSTIC LEDS

The following table lists the module's LEDs and describes what they mean when lit.

High Speed Analog Input Diagnostic LEDs

LED	DESCRIPTION
P (Green)	Power OK LED. Lit when the +5V power is OK
C (Green)	Communications OK LED. Lit when the Controller is communicating with the module.
I (Red)	Internal Error LED. Lit whenever there is any type of error with the module **except** for a loss of power. Possible causes are: ▪ Module initialization is in progress. ▪ I/O Bus timeout has occurred. ▪ Register, static RAM, or FLASH checksum error. ▪ Module reset ▪ Module is uncalibrated. ▪ Forced error has been received from the Controller ▪ Communication between the Field and Logic boards failed
CH1 - CH 8 (Red)	Channel error. Lit whenever there is an error associated with a channel or channels. Possible causes are: ▪ Positive overrange: Input voltage greater than +121% of full scale value (for modules configured as voltage input). ▪ Negative overrange: Input voltage less than -121% of full scale value (for modules configured as voltage input). ▪ Input current less than 2.5mA or blown fuse (for module configured as current input). ▪ An overrange (greater than 24.6mA) of full scale is present (for modules configured as current input) ▪ Self calibration readings out of range.

6.7 SPECIFICATIONS

Electronics Module (5X00070)

Personality Modules (1C31227, 1C31116)

High Speed Analog Input Module Specifications

DESCRIPTION	VALUE
Number of channels	8
Input range	4 - 20 mA, ±1mA 1V, ±5V, ±10V ±20mV, 50mV, ±100V, ±250mV
Resolution	14 bits (including polarity)
Guaranteed accuracy (@25°C)	±0.10% of full scale value ±1/2LSB @99.7% confidence.
Temperature coefficient	±0.24% of the full scale value over 0 to 60°C.
Input impedance:	3.3 MΩ (G02, G04) field configured; 200 MΩ (Go3) field configured; 300 MΩ @20 mA for G01 field configured
Sampling rate (per second)	16 when configured for 50 Hz 20 when configured for 60 Hz
Self-calibration	On demand by the Ovation Controller.
Diagnostics	Internal module operating faults. Out of range detection. Open loop detection for current inputs.
Dielectric isolation: Channel to channel Channel to logic	 1000 V AC/DC 1000 V AC/DC
Normal mode rejection	60 dB @50 Hz ± 1/2% or @60 Hz ± 1/2% (when properly configured) 30 dB (typical) @50 Hz ± 5% or @60 Hz ± 5% (when properly configured)
Common mode rejection	120 dB @ DC or @ the nominal (50/60 Hz) line frequency ± 1/2% and harmonics. 100 dB (typical) for nominal line frequency ± 5% and harmonics.
Module power	Main: 2.4 W typical; 3.125 W maximum Aux: When used (1C31227G01) Aux power supply voltage = 24 V DC 3.84 W typical (8 inputs @ 20mA each)
Operating temperature range	0 to 60°C (32°F to 140°F)
Storage temperature range	-40°C to 85°C (-40°F to 185°F)
Humidity (non-condensing)	0 to 95%

SECTION 7

ANALOG OUTPUT MODULE

IN THIS SECTION

Description *93*
Module Group Information *93*
Wiring Information *94*
Address Location Information *96*
Diagnostic LEDs *98*
Specifications *99*

7.1 DESCRIPTION

The Analog Output Electronics Module uses low-power-drain 12-bit serial digital-to-analog converters (DACs) to provide four isolated output channels. The serial clock and data allow the four channels to be updated every 1.5 ms. The serial interface uses opto-isolators for high-voltage isolation.

The Analog Output Module is applicable for CE Mark Certified Systems.

Note: *I/O Module General Information (see page 15) contains environmental, installation, wiring, and fuse information for I/O modules.*

7.2 MODULE GROUP INFORMATION

7.2.1 ELECTRONICS MODULES (EMODS)

There are four groups of Electronics modules for the Analog Output Module:

- 1C31129G01 provides voltage output range of 0 to 5 V DC.
- 1C31129G02 provides voltage output range of 0 to 10 V.
- 1C31129G03 provides voltage output range of 0 to 20 mA with diagnostics.
- 1C31129G04 provides voltage output range of 0 to 20 mA without diagnostics.

7.2.2 PERSONALITY MODULE (PMOD)

There is one Personality module group for the Analog Output Module:

- 1C31132G01 routes field signals from the Electronics module to the terminal block.

7.2.3 SUBSYSTEMS, ANALOG OUTPUT

Analog Output Subsystems[1]

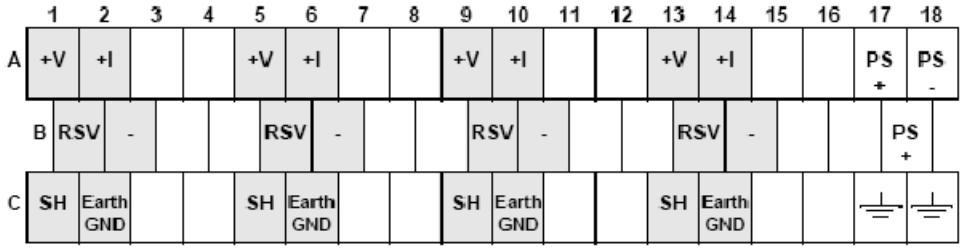
RANGE	CHANNELS	ELECTRONIC MODULE	PERSONALITY MODULE
0-5 Volts DC	4	1C31129G01	1C31132G01
0-10 Volts DC	4	1C31129G02	1C31132G01
0-20 mA with Diagnostics (4-20 mA with Diagnostics can also be selected in the I/O Builder; card will be configured appropriately)	4	1C31129G03	1C31132G01
0-20 mA without Diagnostics (4-20 mA without Diagnostics can also be selected in the I/O Builder; card will be configured appropriately)	4	1C31129G04	1C31132G01
[1] *All Configurations are CE Mark Certified.*			

7.3 WIRING INFORMATION

7.3.1 ANALOG OUTPUT TERMINAL BLOCK WIRING INFORMATION

Each Personality module has a simplified wiring diagram label on its side, which appears above the terminal block. This diagram indicates how the wiring from the field is to be connected to the terminal block in the base unit. The diagram for the analog output Personality module is illustrated in the following figure. The following table lists and defines the abbreviations used in this diagram.

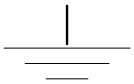
Analog Output: (1C31132G01)



Notes

1. (-) (signal return) and SH (shield) are tied together in the Personality module.
2. PS+ and PS- are not used by the Analog Output module.

Abbreviations Used in Diagrams

ABBREVIATION	DEFINITION
	Earth ground terminals.
+I	Current output source terminal.
RSV	Reserved terminal. No connections allowed on these terminals.
SH	Shield terminal connection (for non-CE Mark certified systems).
+V	Voltage output source terminal connection.
PS+, PS-	Auxiliary power supply terminals.
-	Reference for voltage and current output.

Note: *1. Do **not** use unmarked terminal block locations.*
*2. Shield terminals (SH) are **not** connected in CE Mark systems.*

7.3.2 ANALOG OUTPUT FIELD CONNECTION WIRING DIAGRAMS (NON-CE MARK CERTIFIED)

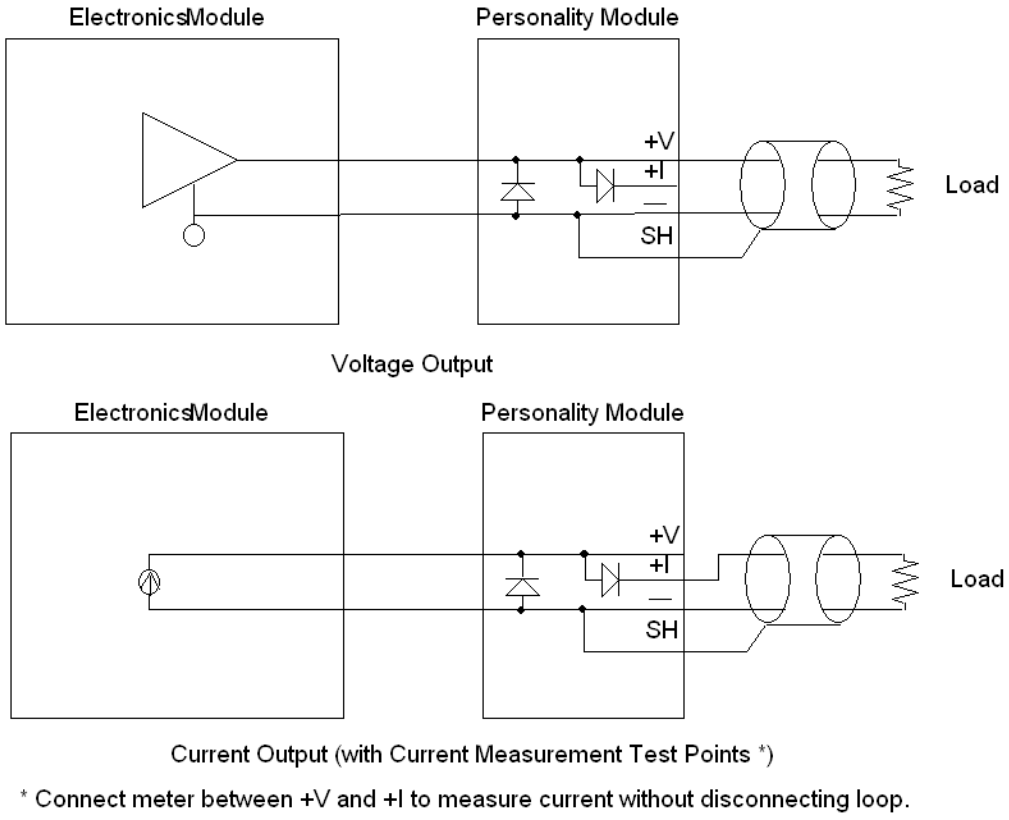


Figure 28: Field Connection for the Analog Output PMod (Non-CE Mark)

7.3.3 Analog Output Field Connection Wiring Diagrams (CE Mark Certified)

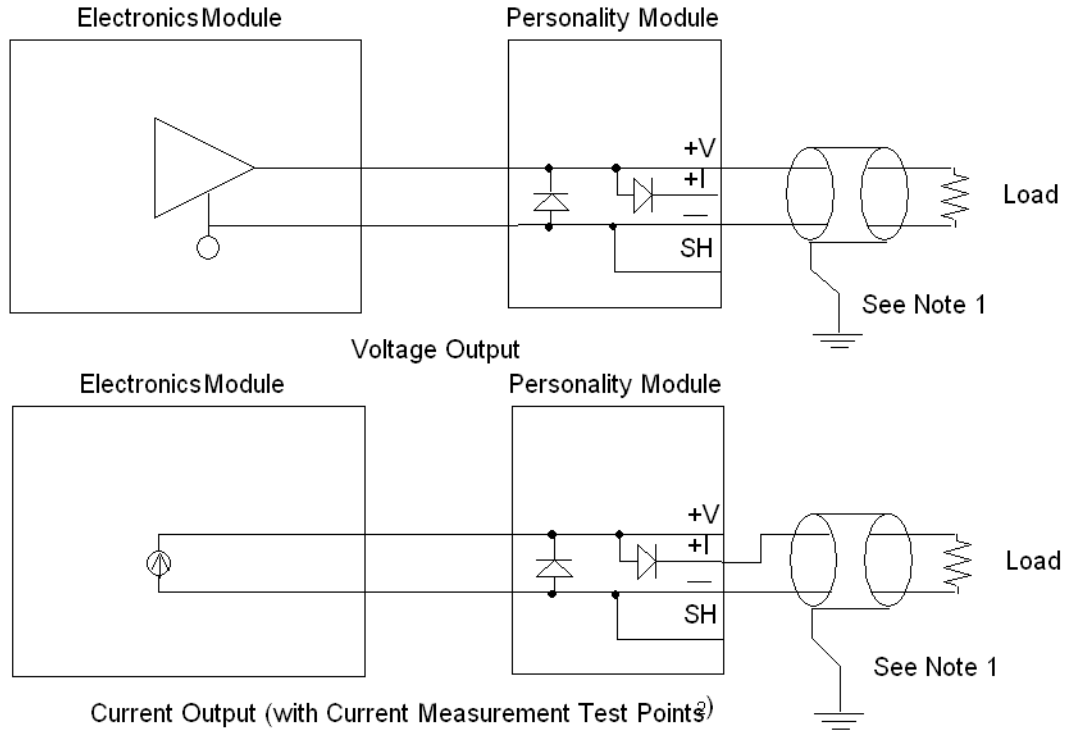


Figure 29: Field Connection for the Analog Output Personality Module (CE Mark)

7.4 Address Location Information

7.4.1 Configuration and Status Register

Word address 13 (D in Hex) is used to configure the module and provide status information to the Controller. The status register can be read by using the Point Information window at an Operator Station (see the Bit Pattern Field on the Hardware Tab). (See the *Ovation Operator Station User Guide.)*

Analog Output Configuration/Status Register (Address 13 or D in Hex)

Bit	Data Description - Configuration Register (Write)	Data Description - Status Register (Read)
0	Configure	Configured (1 = configured; 0 = unconfigured)
1	Force Error	Forced Error (1 = forced error; 0 = no forced error)

<table>
<tr><td>2 - 4</td><td>Communications Timeout Setting [1]
<table><tr><th>Bit 4</th><th>Bit 3</th><th>Bit 2</th><th>Timeout</th></tr><tr><td>0</td><td>0</td><td>0</td><td>16 seconds</td></tr><tr><td>0</td><td>0</td><td>1</td><td>4 seconds</td></tr><tr><td>0</td><td>1</td><td>0</td><td>2 seconds</td></tr><tr><td>0</td><td>1</td><td>1</td><td>1 seconds</td></tr><tr><td>1</td><td>0</td><td>0</td><td>500 milliseconds</td></tr><tr><td>1</td><td>0</td><td>1</td><td>250 milliseconds</td></tr><tr><td>1</td><td>1</td><td>0</td><td>125 milliseconds</td></tr><tr><td>1</td><td>1</td><td>1</td><td>62.5 milliseconds</td></tr></table></td><td>Communications Timeout Setting [1]
<table><tr><th>Bit 4</th><th>Bit 3</th><th>Bit 2</th><th>Timeout</th></tr><tr><td>0</td><td>0</td><td>0</td><td>16 seconds</td></tr><tr><td>0</td><td>0</td><td>1</td><td>4 seconds</td></tr><tr><td>0</td><td>1</td><td>0</td><td>2 seconds</td></tr><tr><td>0</td><td>1</td><td>1</td><td>1 seconds</td></tr><tr><td>1</td><td>0</td><td>0</td><td>500 milliseconds</td></tr><tr><td>1</td><td>0</td><td>1</td><td>250 milliseconds</td></tr><tr><td>1</td><td>1</td><td>0</td><td>125 milliseconds</td></tr><tr><td>1</td><td>1</td><td>1</td><td>62.5 milliseconds</td></tr></table></td></tr>
<tr><td>3</td><td>Communication Timeout Bit [1]</td><td>Communication Timeout Bit 1 [1]</td></tr>
<tr><td>4</td><td>Communication Timeout Bit [1]</td><td>Communication Timeout Bit 2 [1]</td></tr>
<tr><td>5</td><td>Hold Output</td><td>Hold Output</td></tr>
<tr><td>6</td><td>Not used</td><td>Not used</td></tr>
<tr><td>7</td><td>Disable power</td><td>Disable power</td></tr>
<tr><td colspan="3">[1] The tolerance on the timeout period is +/- 35%.</td></tr>
</table>

The bit definitions for this register are encoded as shown in the above table and described below:

Bit 0: When Bit 0 is set, the module is configured. The module cannot be read and will not operate until the configure bit is set with a write. Subsequent writes to address 13 should also have Bit 0 set.

Bit 1: Bit 1 is the Force-Error bit. When Bit 1 is set, the Internal Error LED is turned on, and data registers can be written, but not read.

Bits 2-4: These bits are used to select the communication timeout period.

Bit 5: This bit is Hold Output on communication timeout. If Bit 5 is set and no communication to the module occurs for the defined time period, only the communication LED will go off, and the Internal Error LED will go on, but the outputs will hold their last value.
If Bit 5 is not set and no communication to the module occurs for the defined time period, the outputs will reset to zero and the Internal Error LED will go on.

Bit 6: This bit is not used.

Bit 7: This bit is the disable power bit.

All the bits are cleared to zero on power up.

7.4.2 Output Current Status Register

The register at address 12 (C in Hex) is for diagnostics and is a read-only register. The overcurrent and undercurrent status bits may be read from this register. The following table shows the overcurrent and undercurrent bits for each channel. The overcurrent bits are used for both the voltage groups and current groups. The undercurrent bits only have meaning for the current group. The voltage output groups do not implement the undercurrent bit.

The simultaneous setting of a channel's overcurrent and undercurrent bits indicates a loss of Field Card power supply for that channel. Overcurrent and undercurrent bits indicate the output current status of this module and not the loop current.

Note: *Group 4 current output Field Cards do not have these diagnostic capabilities and the overcurrent and undercurrent bits are strapped in the logical zero state. Since the Group 4 modules do not have diagnostics, the information is not available to the Ovation Controller to support redundancy logic calculations. Groups 1 and 2 do not have undercurrent indication.*

Output Current Status Bits (Address 12 or C in Hex)

Bit	Description
0	Channel 1 Overcurrent
1	Channel 1 Undercurrent
2	Channel 2 Overcurrent
3	Channel 2 Undercurrent
4	Channel 3 Overcurrent
5	Channel 3 Undercurrent
6	Channel 4 Overcurrent
7	Channel 4 Undercurrent

7.5 Diagnostic LEDs

The following table lists the module’s LEDs and describes what they mean when lit.

Analog Output Diagnostic LEDs

LED	Description
P (Green)	Power OK LED. Lit when the +5V power is OK.
C (Green)	Communications OK LED. Lit when the Controller is communicating with the module.

LED	DESCRIPTION
I (Red)	Internal Fault LED. Lit whenever the Force Error bit (Bit 1) of the Configuration Register (see page 96) is set. Also lit when a timeout of the watchdog timer occurs when Controller stops communicating with module.
CH1 - CH 4 (Red)	Channel error. Overcurrent or undercurrent indication. On module groups 1, 2, and 3, the LEDs are lit after power up until the module is configured. On module groups 1 and 2, the LED is on for overcurrent output or loss of output D/A power. On module group 3, the LED is on for overcurrent/undercurrent output or loss of output D/A power. Module group 4 does not have diagnostic LEDs.

7.6 SPECIFICATIONS

Electronics Module (1C31129)

Personality Module (1C31132)

Analog Output Module Specifications

DESCRIPTION	VALUE
Number of channels	4
Maximum update time	2 mSec
Output range	0 – 5 V [1], 0 -10 V [1], 0 - 20 mA [2]
Resolution	12 bits
Guaranteed accuracy (@25°C)	0.1% of full scale.
Temperature coefficient	30 ppm/°C
User loop voltage	Power for current loop output is supplied by module.
Dielectric isolation: Channel to channel Channel to logic	 1000 V AC/DC 1000 V AC/DC
Output loading: Current Voltage	 0 Ω minimum; 750 Ω maximum 10 mA maximum
Module power Current output Voltage output	 4 W typical; 6 W maximum 2 W typical; 3 W maximum

DESCRIPTION	VALUE
Operating temperature range	0 to 60°C (32°F to 140°F)
Storage temperature range	-40°C to 85°C (-40°F to 185°F)
Humidity (non-condensing)	0 to 95%
[1] Overcurrent load indications. [2] Module supplied loop voltage, overcurrent and undercurrent diagnostic indication. Provides the ability to measure current without disconnecting loop.	

SECTION 8

CONTACT INPUT MODULE

IN THIS SECTION

Description *102*
Module Group Information *102*
Wiring Information *103*
Address Location Information *109*
Diagnostic LEDs *110*
Specifications *111*

8.1 DESCRIPTION

The Contact Input Module, comprised of an Electronics module and Personality module, provides 16 contact input current detecting channels with common returns. The field side circuitry and terminal connections (see page 105) for three of these channels are shown (see page 104).

A +48V on-board power supply provides current limited contact wetting voltage if the contact is open. If the contact closes, current is drawn from the +10V supply which turns on the associated opto-isolator; thereby, relaying a closed contact state to the I/O bus. The opto-isolators and the isolation provided by the 10V and 48 Volt power supply provide high dielectric isolation between the field side and the logic or I/O bus side.

There are two methods of wiring field devices to the Contact Input Module termination block (see page 105). Each field contact may have a separate input and return line as shown for channel 1. Alternatively, field contacts wired to the same Contact Input Module may share a return line as shown for channels 2 and 3. For either wiring method, **do not** tie the contact return line to earth ground or a ground fault condition will occur as well as a degradation of the common mode surge protection.

Debouncing of a contact input signal is done by an RC filter and digital debouncer on the logic side. If a contact changes state for less than 3 msec, the change of state will always be rejected. If the Contact changes state for more than 7 msec, the change of state will always be accepted.

Ground fault detection circuitry on a Contact Input Module activates when an input or return line for any channel finds a low impedance (<5 K ohms) path to earth ground. A single ground fault wire will not cause an error in the point data, but multiple ground faults (if they include input and return lines) could cause faulty data (that is, channels appearing as if contacts are closed when they are really open).

When a ground fault occurs, the external error LED lights, and the GND Fault bit in the Status Register (see page 109) is set. If the GND Fault (see page 105) Attention Enable bit is set in the Configuration Register (see page 109), a ground fault is seen as a catastrophic error causing an attention status to be sent back to the Controller. The Contact Input Module is applicable for CE Mark Certified Systems.

Note: *I/O Module General Information (see page 15) contains environmental, installation, wiring, and fuse information for I/O modules.*

8.2 MODULE GROUP INFORMATION

8.2.1 ELECTRONICS MODULE (EMOD)

There is one Electronics module group for the Contact Input Module:

- **1C31142G01** provides 48 VDC on-card auxiliary power for 16 contact inputs with common return.

8.2.2 PERSONALITY MODULE (PMOD)

There is one Personality module group for the Contact Input Module:

- **1C31110G03** contains surge-protection components for 16 inputs.

8.2.3 SUBSYSTEMS, CONTACT INPUT

Contact Input Subsystems

RANGE	CHANNELS	ELECTRONIC MODULE	PERSONALITY MODULE
48 VDC On-Card Auxiliary	16	1C31142G01	1C31110G03
All Configurations are CE Mark Certified.			

8.3 WIRING INFORMATION

8.3.1 CONTACT INPUT TERMINAL BLOCK WIRING INFORMATION

Each Personality module has a simplified wiring diagram label on its side, which appears above the terminal block. This diagram indicates how the wiring from the field is to be connected to the terminal block in the base unit. The diagram for the contact input Personality module (also known as digital input) is illustrated in the following figure.

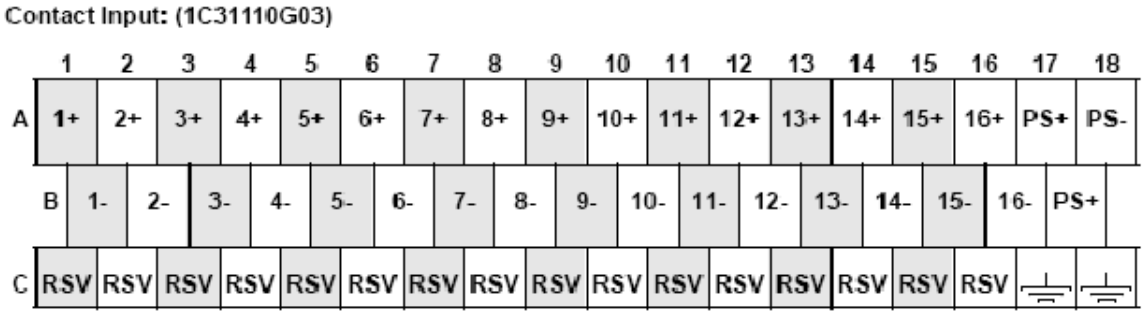
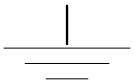


Figure 30: Terminal Block Connections for the Contact Input Personality Modules

The following table lists and defines the abbreviations used in this diagram.

Abbreviations Used in Diagrams

ABBREVIATION	DEFINITION
1+ through 16+	Contact input positive terminal connection
1- through 16-	Contact input negative terminal connection
	Earth ground terminals
PS+, PS-	Auxiliary Power Supply terminals
RSV	Reserved terminal. No connection allowed on these terminals

Note: *Do* ***not*** *use terminal block locations marked RSV.*

8.3.2 FIELD WIRING RESTRICTIONS:

The following definitions apply to the restrictions listed below:

- Rshunt = contact shunt resistance
- Rcontact = resistance associated with a closed contact
- Rreturn = resistance of the common return line
- Rline = resistance of the non-common cable length to and from the contact
- Rwiring = Rcontact + Rline + 16Rreturn
- Rfault = resistance from either line to ground which causes a ground fault

Cable resistances (see page 106) that affect contact input performance. The following restrictions apply:

- Under no-ground-fault conditions or if the channel return (low) line has a ground fault:
  - ☐ Rshunt across contact must be ≥ 10k ohms to always recognize an open contact as open.
  - ☐ Rshunt across contact must be ≥ 50k ohms to maintain the high level contact-wetting voltage.
- If the input connection from a channel has a ground fault with the contact open:
  - ☐ Rshunt across contact must be ≥ 150k ohms to guarantee ground fault is detected.
- For a ground fault on the input or return connection to a channel:
  - ☐ Rfault from either line to ground must be ≤ 5K ohms to guarantee detection of the ground fault.
- With or without ground fault conditions:
  - ☐ Rwiring through field wiring to contact must by < 100 ohms to always recognize a closed contact as closed.

8.3.3 FIELD WIRING CABLE LENGTHS

The following two tables list the maximum cable lengths for field wiring to the contacts. For both, assume Rcontact is 0 ohms.

The following table applies when there are individual common return lines brought to the card edge. This implies that Rreturn is 0 ohms.

Maximum Cable Length for 16 Individual Common Returns

WIRE GAUGE	OHMS PER THOUSAND FEET - (SOLID COPPER WIRE)	MAXIMUM CABLE LENGTH - (THOUSANDS OF FEET)
18	6.64	7.5
20	10.2	4.9
22	16.2	3.0

The following table applies when all 16 channels share a common return line. In both tables, the Maximum Cable Length is the length of the cables from the termination block to the contacts in the field.

Maximum Cable Length for a Single Common Return for All 16 Inputs

WIRE GAUGE	OHMS PER THOUSAND FEET - (SOLID COPPER WIRE)	MAXIMUM CABLE LENGTH - (THOUSANDS OF FEET)
12	1.66	3.54
14	2.27	2.59
16	4.18	1.40
18	6.64	0.89

8.3.4 CONTACT INPUT FRONT END FIELD CONNECTION WIRING DIAGRAMS

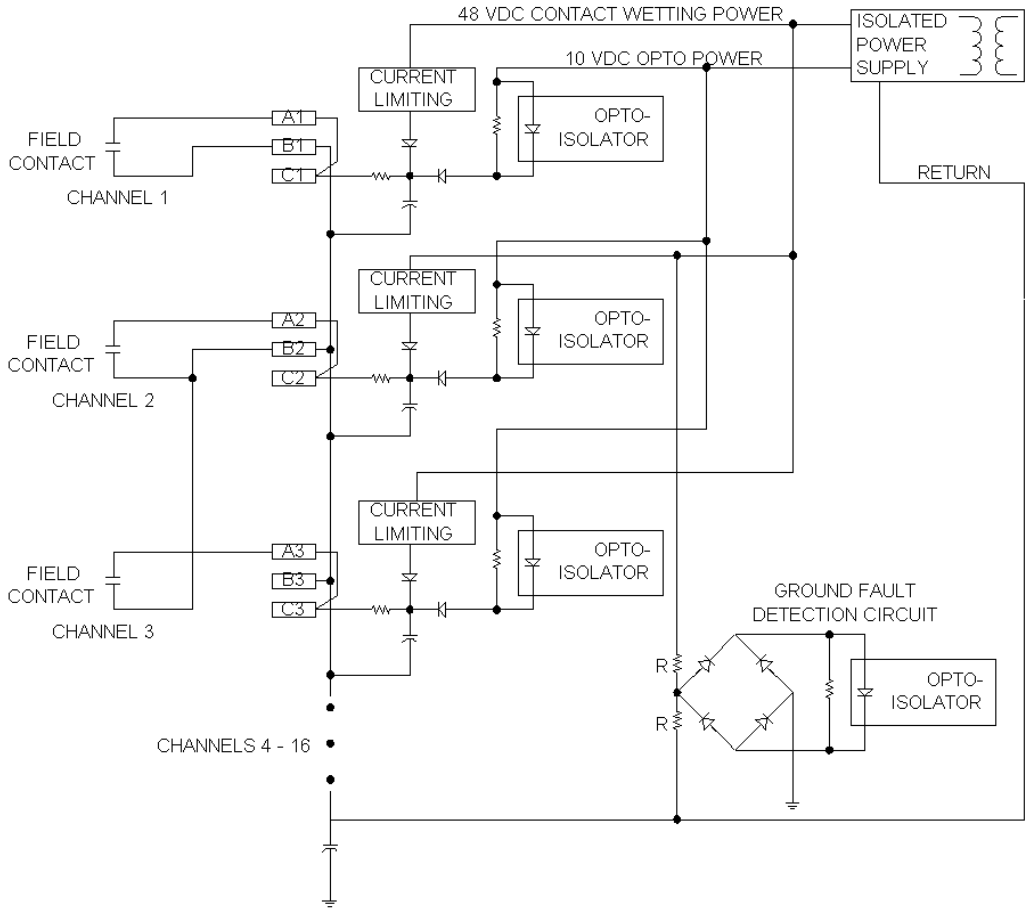


Figure 31: Contact Input Module Front End

8.3.5 CONTACT INPUT CABLE IMPEDANCES IN FIELD WIRING

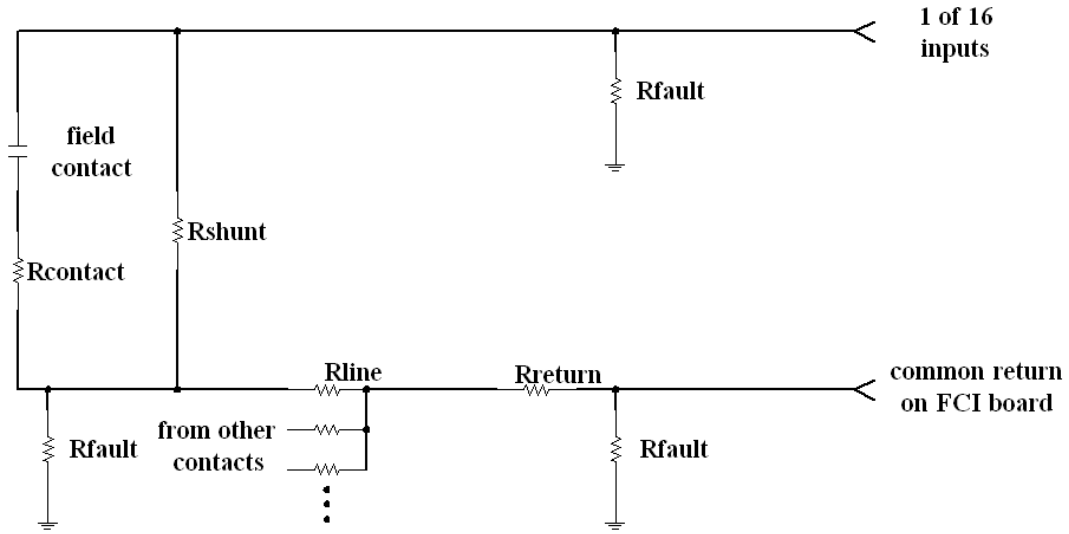


Figure 32: Cable Impedances in Field Wiring

Non-CE Mark Certified Systems

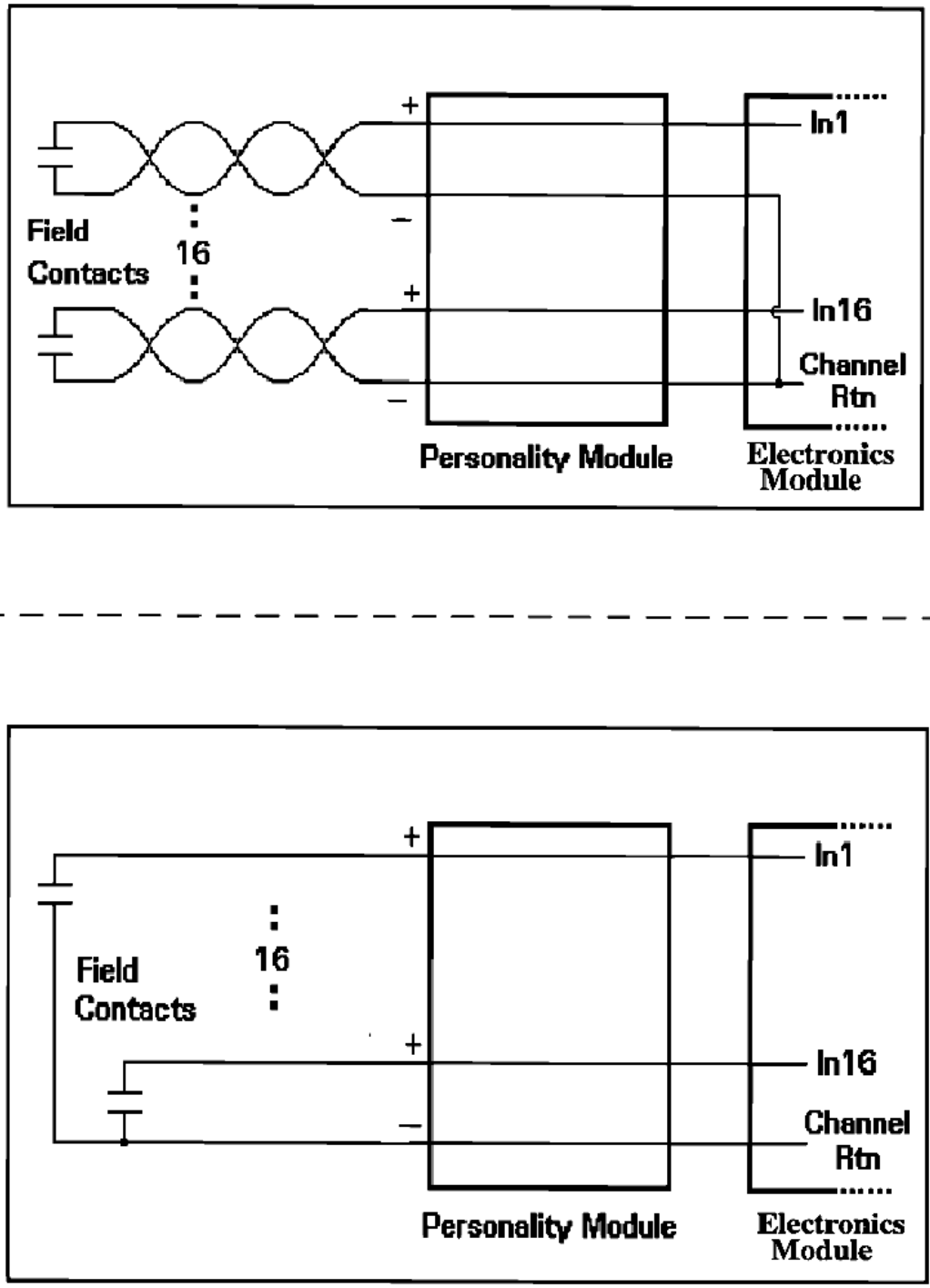


Figure 33: Field Connection for the Contact Input Personality Module (Non-CE Mark)

CE Mark Certified Systems

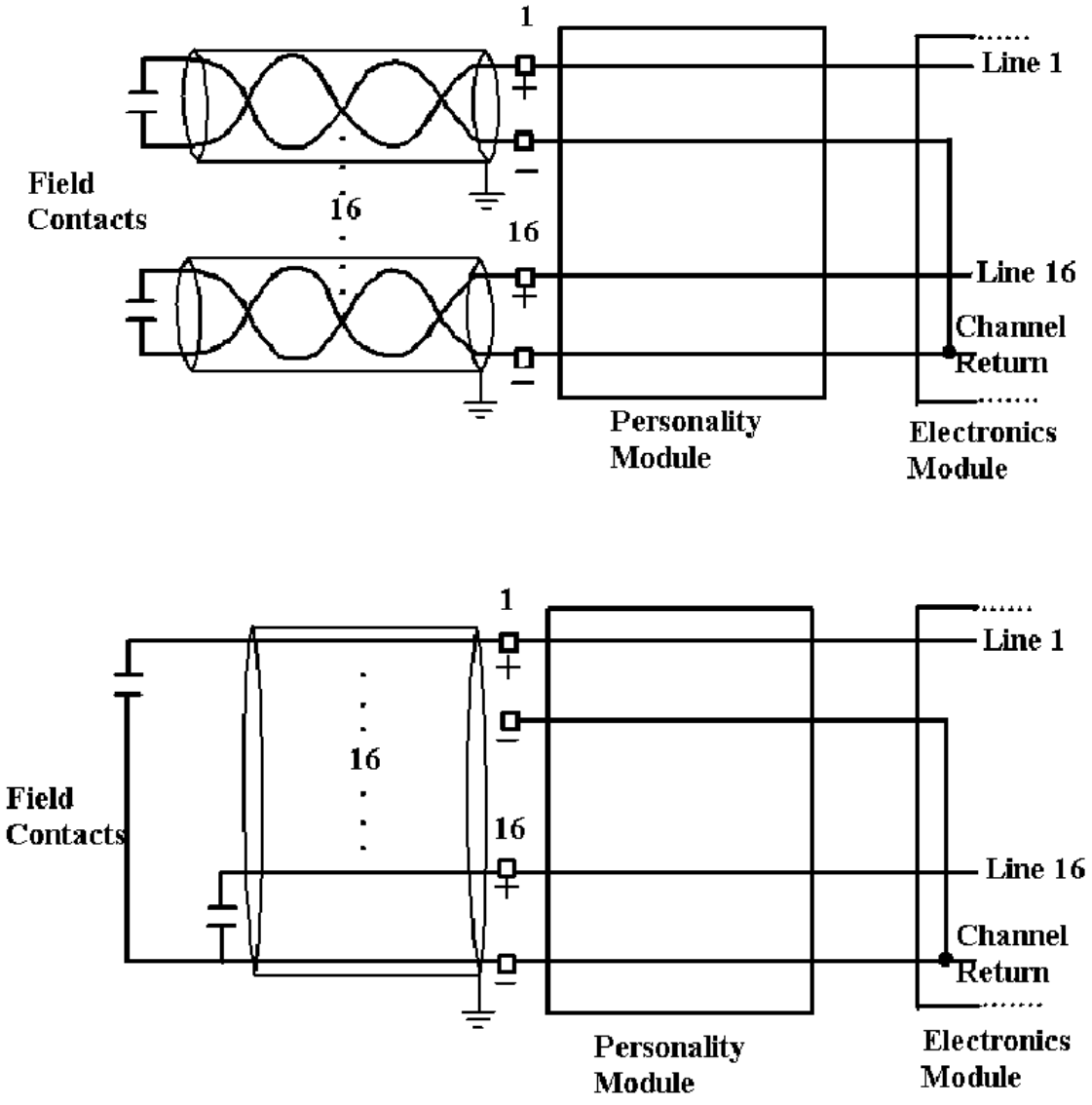


Figure 34: Field Connection for the Contact Input Personality Module (CE Mark)

Note: *All field wiring MUST be braid-shielded and grounded at the entry point of the cabinet using the recommended hardware.*

8.4 Address Location Information

8.4.1 Configuration and Status Register

Word address 13 (D in Hex) is used to configure the module and provide status information to the Controller. The status register can be read by using the Point Information window at an Operator Station (see the Bit Pattern field on the Hardware tab). (See the *Ovation Operator Station User Guide.)*

Contact (and Compact Contact) Input Configuration/Status Register (Address 13 or D in Hex)

Bit	Data Description - Configuration Register (Write)	Data Description - Status Register (Read)
0	Configure Module (1 = configure; 0 = unconfigure, causing an attention status)	Module Configured (1 = configured; 0 = unconfigured)
1	Force Error (1 = force an attention status to be read by Controller; 0 = no forced error)	Forced error (1 = forced error set by Controller; 0 = no forced error)
2	Not defined	Not defined
3	Not defined	Not defined
4	Not defined	Not defined
5	Not defined	Not defined
6	Reserved	Reserved
7	Not defined	Reserved
8	Not defined	Auxiliary Voltage Failure. (1 = +48V auxiliary Voltage Failed; 0 = +48V auxiliary Voltage OK.)
9	Ground Fault Attention Enable (1 = configure GND fault to cause an attention status; 0 = configure GND fault to not cause an attention status)	Ground Fault Attention Enable (1 = GND fault causes attention status 0 = GND fault does not cause an attention status)
10	Not defined	Ground Fault (1 = field wiring has a ground fault; 0 = field wiring does not have a ground fault)
11	Not defined	Not defined
12	Not defined	Not defined
13	Not defined	Not defined
14	Not defined	Not defined
15	Not defined	Not defined

The bit definitions for this register are encoded as shown in the above table and described below:

Bit 0: After the Contact Input Module power is cycled, this bit is “0.” A “1” must be written to the Configure Module bit. If the module is not configured in this manner, an attention status will be sent to the Controller upon an attempt to read the point data. The bit may be read back through the Status Register.

Bit 1: The Force Error bit is “0” after the Contact Input module power is cycled. If the Controller sets the Force Error bit, an attention status is issued. The bit may be read back through the Status Register.

Bits 2-5, 7-8, & 10-15: These bits are not defined in the Configuration register and will be read as high in the Status register. These bits cannot be accessed by the Controller during a write to the module.

Bit 6 & 7: These bits are reserved in the Status Register.

Bit 8: This bit is set in the Status Register if the +48V supply on the FCI board fails.

Bit 9: The GND Fault Attention Enable bit is “0” after the Contact Input module power is cycled. This bit must be set by the Controller if a ground fault is to be treated as a catastrophic failure. If Bit 9 is set, a ground fault will cause an attention status to be returned to the Controller upon accessing the module, and no point data can be read. If the bit is not set, a ground fault will not inhibit the Controller from reading point data. In the latter case, if more than one ground fault occurs on the field wiring to a Contact Input Module, false point data may possibly be read on channels with open contacts.

Bit 10: This bit is set in the Status Register if a ground fault occurs in the field wiring.

8.5 DIAGNOSTIC LEDS

The following table lists the module’s LEDs and describes what they mean when lit.

Contact Input Diagnostic LEDs

LED	DESCRIPTION
P (Green)	Power OK LED. Lit when the +5V power is OK.
C (Green)	Communications OK LED. Lit when the Controller is communicating with the module.
E (Red)	External Fault LED. Lit when GND Fault bit (Bit 10) of the Status Register (see page 109) is set. This indicates that a ground fault has occurred in the field wiring. An attention status is generated when the External Fault LED is lit only if the GND Fault Attention Enable bit (Bit 9) is set.
I (Red)	Internal Fault LED. Lit whenever the Force Error bit (Bit 1) of the Configuration Register is set or when the on-board +48V/+10/V auxiliary power supply fails. Also lit when a timeout of the watchdog timer occurs when Controller stops communicating with module. An attention status is always generated when the LED is lit.
CH1 - CH 16 (Green)	Point Status LED. Lit when the input contact of the LED’s corresponding channel is closed.

8.6 SPECIFICATIONS

Electronics Module (1C31142)

Personality Module (1C31110)

Contact Input Module Specifications

DESCRIPTION	VALUE
Number of channels	16
On board auxiliary power supply	42 V minimum 55 V maximum
Propagation delay	7 mSec maximum
Contact bounce rejection Always rejects contact change of state Always accepts contact change of state	 < 3 mSec > 7 mSec
Closed contact output current	4 mA minimum 8 mA maximum
Diagnostics	Internal module operating faults Ground Fault Detection
Dielectric isolation: Channel to logic	 1000 V AC/DC
Module power	4.56 W typical 4.75 W maximum
Operating temperature range	0 to 60°C (32°F to 140°F)
Storage temperature range	-40°C to 85°C (-40°F to 185°F)
Humidity (non-condensing)	0 to 95%

SECTION 9

COMPACT CONTACT INPUT MODULE

IN THIS SECTION

Description *114*
Module Group Information *114*
Wiring Information *115*
Address Location Information *122*
Diagnostic LEDs *123*
Specifications *124*

9.1 DESCRIPTION

The Compact Contact Input Module, comprised of an Electronics module, provides 16 contact input current detecting channels with common returns.

Additionally, a foam insert that includes a wiring diagram is available for placement in the Personality module cavity in the base unit.

A +48V on-board power supply provides current limited contact wetting voltage if the contact is open. If the contact closes, current is drawn from the +10V supply which turns on the associated opto-isolator; thereby, relaying a closed contact state to the I/O bus. The opto-isolators and the isolation provided by the 10V and 48 Volt power supply provide high dielectric isolation between the field side and the logic or I/O bus side.

There are two methods of wiring field devices to the Compact Contact Input Module termination block (see page 118). Each field contact may have a separate input and return line as shown for channel 1. Alternatively, field contacts wired to the same Contact Input Module may share a return line as shown for channels 2 and 3. For either wiring method, **do not** tie the contact return line to earth ground or a ground fault condition will occur as well as a degradation of the common mode surge protection.

Debouncing of a contact input signal is done by an RC filter and digital debouncer on the logic side. If a contact changes state for less than 3 msec, the change of state will always be rejected. If the Contact changes state for more than 7 msec, the change of state will always be accepted.

Ground fault detection circuitry on the Compact Contact Input Module activates when the input or return line for any channel finds a low impedance (<5K ohms) path to earth ground. A single wire with a ground fault will not cause an error in the point data, but multiple ground faults, if they include input and return lines, could cause faulty data (that is, channels appearing as if their contacts are closed when they are really open).

When a ground fault occurs, the external error LED lights, and the GND Fault bit in the Status Register is set. If the GND Fault Attention Enable bit is set in the Configuration Register, a ground fault (see page 118) is seen as a catastrophic error causing an attention status to be sent back to the Controller.

The Compact Contact Input module is applicable for CE Mark certified systems.

Note: *I/O Module General Information (see page 15) contains environmental, installation, wiring, and fuse information for I/O modules.*

9.2 MODULE GROUP INFORMATION

9.2.1 ELECTRONICS MODULE (EMOD)

There is one Electronics module group for the Compact Contact Input module:

- **1C31234G01** provides 48 VDC on-card auxiliary power for 16 contact inputs with common return.

9.2.2 FOAM INSERT

There is no Personality module for the Compact Contact Input module. A foam insert is available that fits into the Personality module cavity in the Base Unit and provides wiring information.

- **1C31238H01**

9.2.3 SUBSYSTEMS, COMPACT CONTACT INPUT

Compact Contact Input Subsystems [1]

RANGE	CHANNELS	ELECTRONIC MODULE	CAVITY INSERT [2]
Compact Contact with 48 VDC On-Card Auxiliary	16	1C31234G01	1C31238H01

[1] *All Configurations are CE Mark Certified.*

[2] This is an insert that fits into the Personality module position and provides a wiring schematic label for the module. There is no actual Personality module required for this module type.

9.3 WIRING INFORMATION

9.3.1 COMPACT CONTACT INPUT TERMINAL BLOCK WIRING INFORMATION

The available foam insert has a simplified wiring diagram label on its top, which appears above the terminal block. This diagram indicates how the wiring from the field is to be connected to the terminal block in the base unit. The diagram for the Compact Contact Input module is illustrated in the following figure. The following table lists and defines the abbreviations used in this diagram.

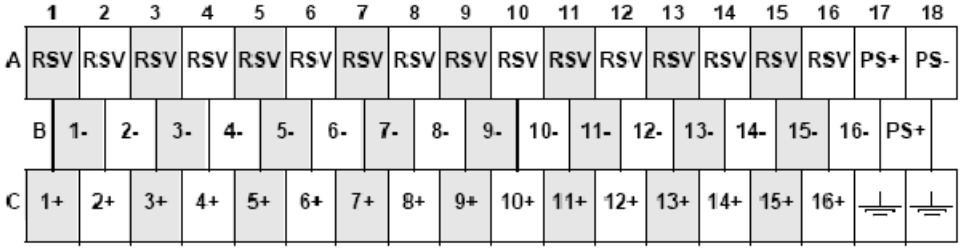
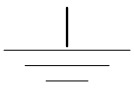


Figure 35: Terminal Block Connections for the Compact Contact Input Modules

Abbreviations Used in Diagrams

ABBREVIATION	DEFINITION
1+ through 16+	Contact input positive terminal connection
1- through 16-	Contact input negative terminal connection
	Earth ground terminals

ABBREVIATION	DEFINITION
PS+, PS-	Auxiliary Power Supply terminals
RSV	Reserved terminal. No internal connection

9.3.2 FIELD WIRING RESTRICTIONS:

The following definitions apply to the restrictions listed below:

- Rshunt = contact shunt resistance
- Rcontact = resistance associated with a closed contact
- Rreturn = resistance of the common return line
- Rline = resistance of the non-common cable length to and from the contact
- Rwiring = Rcontact + Rline + 16Rreturn
- Rfault = resistance from either line to ground which causes a ground fault

Cable resistances (see page 119) that affect contact input performance. The following restrictions apply:

- Under no-ground-fault conditions or if the channel return (low) line has a ground fault:
  - ☐ Rshunt across contact must be ≥ 10k ohms to always recognize an open contact as open.
  - ☐ Rshunt across contact must be ≥ 50k ohms to maintain the high level contact-wetting voltage.
- If the input connection from a channel has a ground fault with the contact open:
  - ☐ Rshunt across contact must be ≥ 150k ohms to guarantee ground fault is detected.
- For a ground fault on the input or return connection to a channel:
  - ☐ Rfault from either line to ground must be ≤ 5K ohms to guarantee detection of the ground fault.
- With or without ground fault conditions:
  - ☐ Rwiring through field wiring to contact must by < 100 ohms to always recognize a closed contact as closed.

9.3.3 FIELD WIRING CABLE LENGTHS

The following two tables list the maximum cable lengths for field wiring to the contacts. For both, assume Rcontact is 0 ohms.

The following table applies when there are individual common return lines brought to the card edge. This implies that Rreturn is 0 ohms.

Maximum Cable Length for 16 Individual Common Returns

WIRE GAUGE	OHMS PER THOUSAND FEET - (SOLID COPPER WIRE)	MAXIMUM CABLE LENGTH - (THOUSANDS OF FEET)
18	6.64	7.5
20	10.2	4.9
22	16.2	3.0

The following table applies when all 16 channels share a common return line. In both tables, the Maximum Cable Length is the length of the cables from the termination block to the contacts in the field.

Maximum Cable Length for a Single Common Return for All 16 Inputs

WIRE GAUGE	OHMS PER THOUSAND FEET - (SOLID COPPER WIRE)	MAXIMUM CABLE LENGTH - (THOUSANDS OF FEET)
12	1.66	3.54
14	2.27	2.59
16	4.18	1.40
18	6.64	0.89

9.3.4 COMPACT CONTACT INPUT FRONT END FIELD CONNECTION WIRING DIAGRAMS

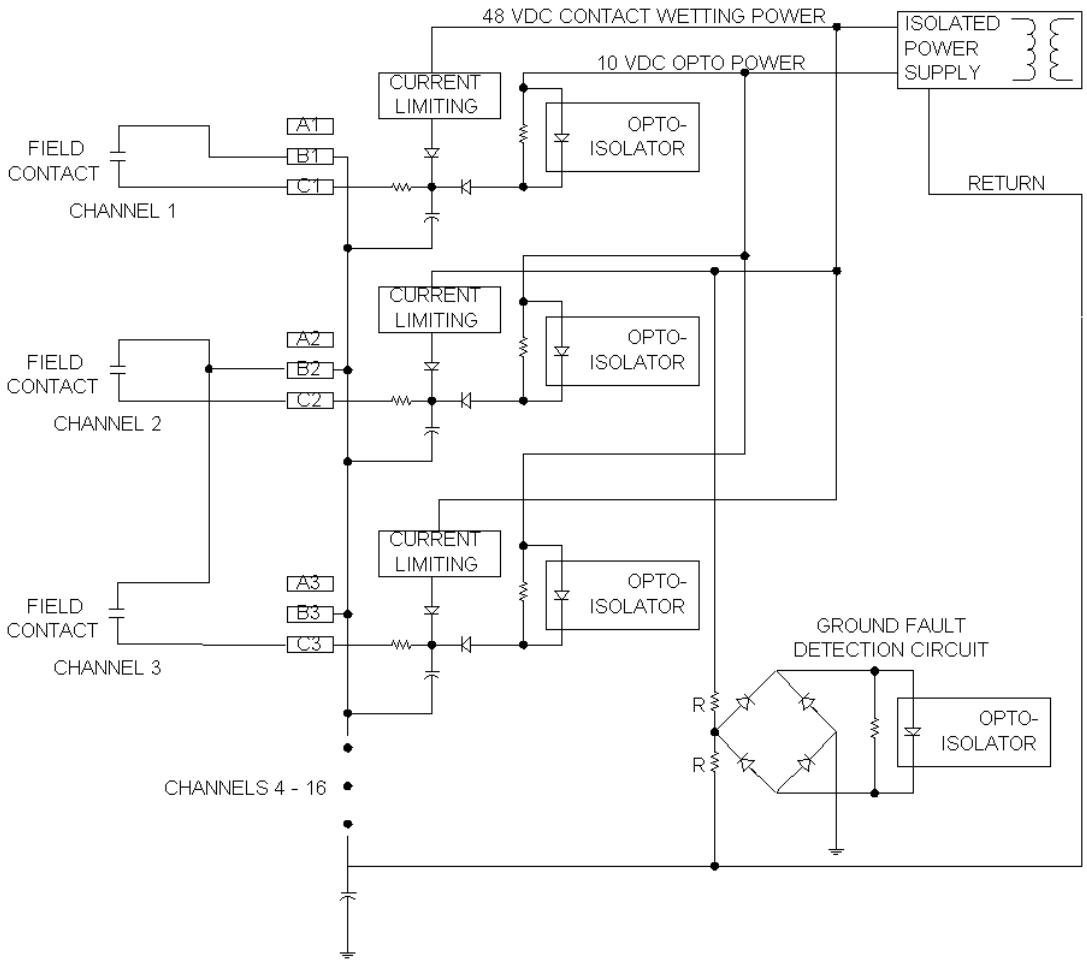


Figure 36: Compact Contact Input Module Front End

9.3.5 COMPACT CONTACT INPUT CABLE IMPEDANCES IN FIELD WIRING

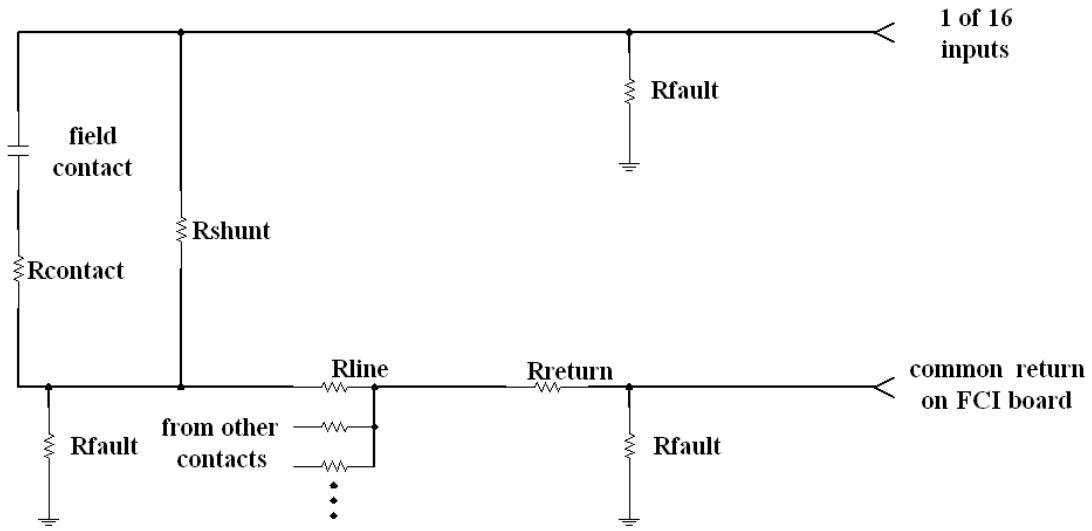


Figure 37: Cable Impedances in Field Wiring

Non-CE Mark Certified Systems

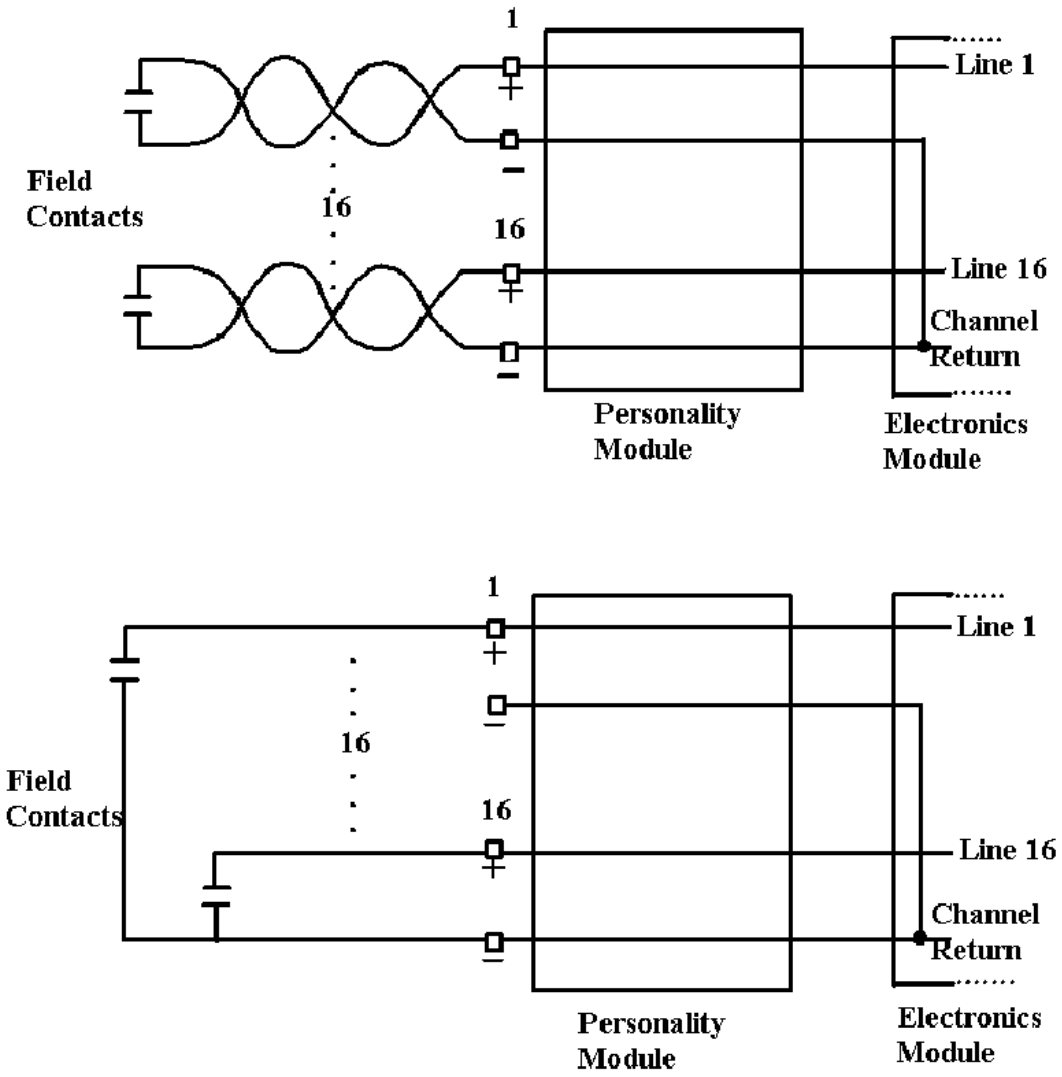


Figure 38: Field Connection for the Compact Contact Input Module (Non-CE Mark)

CE Mark Certified Systems

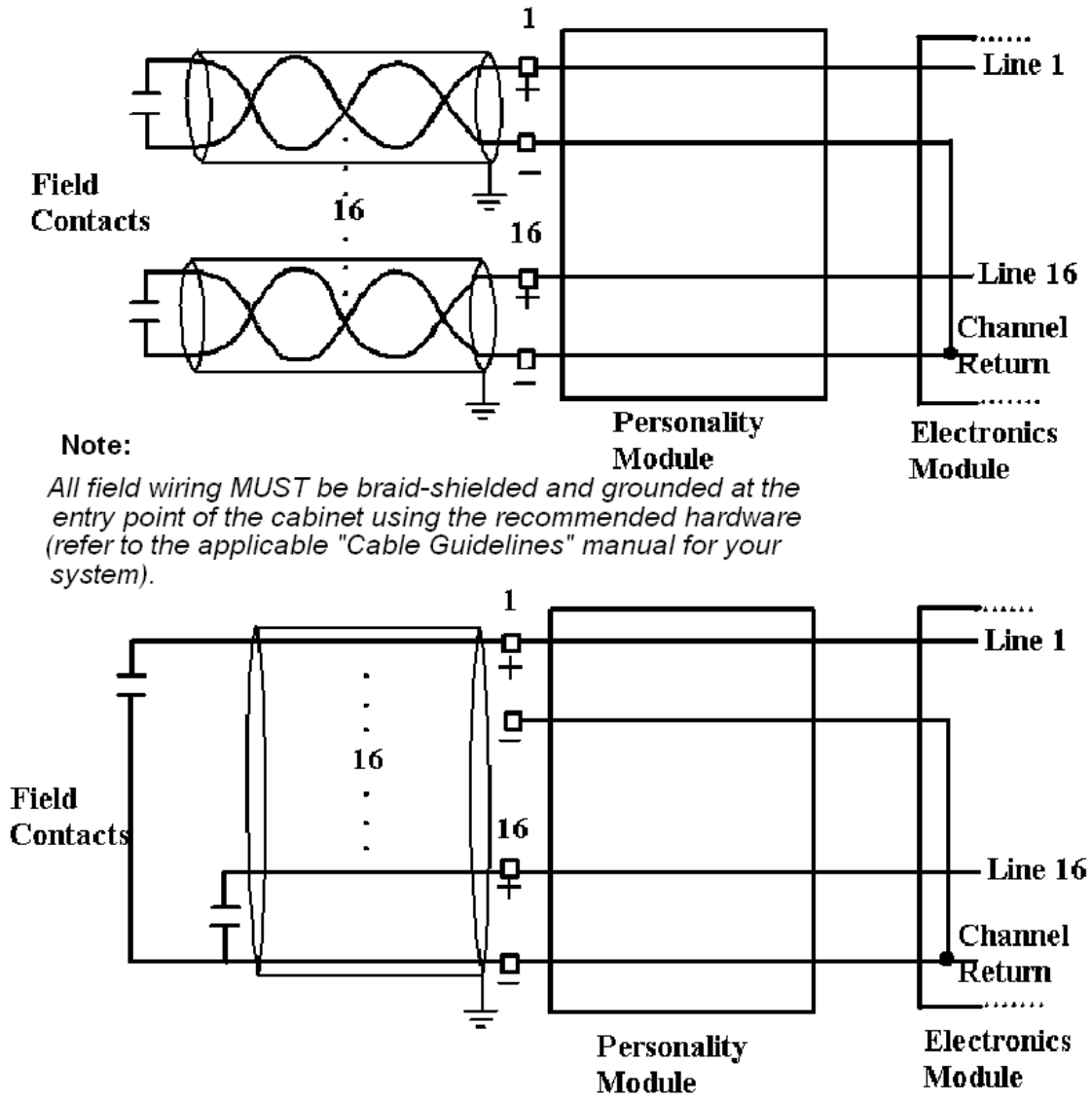


Figure 39: Field Connection for the Compact Contact Input Module (CE Mark)

9.4 Address Location Information

9.4.1 Configuration and Status Register

Word address 13 (D in Hex) is used to configure the module and provide status information to the Controller. The status register can be read by using the Point Information window at an Operator Station (see Bit Pattern field on the Hardware tab). (See *Ovation Operator Station User Guide.)*

Contact (and Compact Contact) Input Configuration/Status Register (Address 13 or D in Hex)

Bit	Data Description - Configuration Register (Write)	Data Description - Status Register (Read)
0	Configure Module (1 = configure; 0 = unconfigure, causing an attention status)	Module Configured (1 = configured; 0 = unconfigured)
1	Force Error (1 = force an attention status to be read by Controller; 0 = no forced error)	Forced error (1 = forced error set by Controller; 0 = no forced error)
2	Not defined	Not defined
3	Not defined	Not defined
4	Not defined	Not defined
5	Not defined	Not defined
6	Reserved	Reserved
7	Not defined	Reserved
8	Not defined	Auxiliary Voltage Failure. (1 = +48V auxiliary Voltage Failed; 0 = +48V auxiliary Voltage OK.)
9	Ground Fault Attention Enable (1 = configure GND fault to cause an attention status; 0 = configure GND fault to not cause an attention status)	Ground Fault Attention Enable (1 = GND fault causes attention status 0 = GND fault does not cause an attention status)
10	Not defined	Ground Fault (1 = field wiring has a ground fault; 0 = field wiring does not have a ground fault)
11	Not defined	Not defined
12	Not defined	Not defined
13	Not defined	Not defined
14	Not defined	Not defined
15	Not defined	Not defined

The bit definitions for this register are encoded as shown in the above table and described below:

Bit 0: After the Contact Input Module power is cycled, this bit is “0.” A “1” must be written to the Configure Module bit. If the module is not configured in this manner, an attention status will be sent to the Controller upon an attempt to read the point data. The bit may be read back through the Status Register.

Bit 1: The Force Error bit is “0” after the Contact Input module power is cycled. If the Controller sets the Force Error bit, an attention status is issued. The bit may be read back through the Status Register.

Bits 2-5, 7-8, & 10-15: These bits are not defined in the Configuration register and will be read as high in the Status register. These bits cannot be accessed by the Controller during a write to the module.

Bit 6 & 7: These bits are reserved in the Status Register.

Bit 8: This bit is set in the Status Register if the +48V supply on the FCI board fails.

Bit 9: The GND Fault Attention Enable bit is “0” after the Contact Input module power is cycled. This bit must be set by the Controller if a ground fault is to be treated as a catastrophic failure. If Bit 9 is set, a ground fault will cause an attention status to be returned to the Controller upon accessing the module, and no point data can be read. If the bit is not set, a ground fault will not inhibit the Controller from reading point data. In the latter case, if more than one ground fault occurs on the field wiring to a Contact Input Module, false point data may possibly be read on channels with open contacts.

Bit 10: This bit is set in the Status Register if a ground fault occurs in the field wiring.

9.5 DIAGNOSTIC LEDS

The following table lists the module’s LEDs and describes what they mean when lit.

Compact Contact Input Diagnostic LEDs

LED	DESCRIPTION
P (Green)	Power OK LED. Lit when the +5V power is OK
C (Green)	Communications OK LED. Lit when the Controller is communicating with the module.
E (Red)	External Fault LED. Lit when GND Fault bit (Bit 10) of the Status Register is set. This indicates that a ground fault has occurred in the field wiring. An attention status is generated when the External Fault LED is lit only if the GND Fault Attention Enable bit (Bit 9) is set.
I (Red)	Internal Fault LED. Lit whenever the Force Error bit (Bit 1) of the Configuration Register is set or when the on-board +48V/+10/V auxiliary power supply fails. Also lit when a timeout of the watchdog timer occurs when Controller stops communicating with module. An attention status is always generated when the LED is lit.
CH1 - CH 16 (Green)	Point Status LED. Lit when the input contact of the LED’s corresponding channel is closed.

9.6 SPECIFICATIONS

Electronics Module (1C31234)

Compact Contact Input Module Specifications

DESCRIPTION	VALUE
Number of channels	16
On board auxiliary power supply	42 V minimum 55 V maximum
Propagation delay	7 mSec maximum
Contact bounce rejection Always rejects contact change of state Always accepts contact change of state	 < 3 mSec > 7 mSec
Closed contact output current	4 mA minimum 8 mA maximum
Diagnostics	Internal module operating faults Ground Fault Detection
Dielectric isolation: Channel to logic	 1000 V AC/DC
Module power	4.56 W typical 4.75 W maximum
Operating temperature range	0 to 60°C (32°F to 140°F)
Storage temperature range	-40°C to 85°C (-40°F to 185°F)
Humidity (non-condensing)	0 to 95%

SECTION 10

DIGITAL INPUT MODULE

IN THIS SECTION

Description *125*
Module Group Information *125*
Module Specific Information *127*
Wiring Information *129*
Address Location Information *133*
Diagnostic LEDs *134*
Specifications *135*

10.1 DESCRIPTION

The Digital Input module contains 16 channels where each channel has voltage level sensing circuitry used to detect whether an input is on or off. The module is available with 16 isolated differential inputs, or 16 single-ended (common return) digital inputs with on-card blown fuse detection for the auxiliary power supply. The selection of the personality module determines if the inputs are differential or single-ended. The input voltage level monitored by the module is determined by the particular card group in the module.

The field side circuitry for the single ended configuration (see page 127), and for the differential configuration (see page 128) are described in their respective sections An input resistor provides the normal mode surge protection and limits the current during normal operation. An opto-isolator provides high dielectric isolation between the field side and the logic or I/O bus side.

The Single-Ended Digital Input configuration has a circuit used to monitor the presence of the auxiliary supply. Two cases cause this monitor circuitry to report a blown fuse status and issue an attention status to the Ovation Controller:

- Fuse is blown on the Personality Module.
- Auxiliary supply level is lower than minimum On Input Voltage.

Note: *I/O Module General Information (see page 15) contains environmental, installation, wiring, and fuse information for I/O modules.*

10.2 MODULE GROUP INFORMATION

10.2.1 ELECTRONICS MODULES (EMODS)

There are two Electronics module for the Digital Input Module:

- **1C31107G01** provides for 24/48 VAC/VDC single-ended or differential inputs.
- **1C31107G02** provides for 125 VAC/VDC single-ended or differential inputs.

10.2.2 PERSONALITY MODULES (PMODS)

There are two Personality module groups for the Digital Input Module:

- **1C31110G01** provides for single-ended inputs.
- **1C31110G02** provides for differential inputs.

10.2.3 SUBSYSTEMS, DIGITAL INPUT

Digital Input Subsystems [1]

RANGE	CHANNELS	ELECTRONIC MODULE	PERSONALITY MODULE
24/48 VAC/VDC			
Single-ended	16	1C31107G01	1C31110G01
Differential	16	1C31107G01	1C31110G02
125 VAC/VDC			
Single-ended	16	1C31107G02	1C31110G01
Differential	16	1C31107G02	1C31110G02
[1] All configurations are CE Mark Certified.			

When the 125VAC/VDC Digital Input Emod (1C31107G02) is used in applications without the Fused Pmod (5X00034G01), additional external fusing or other current limiting devices are recommended on the hazardous inputs to provide additional protection to the external wiring and power source.

CAUTION! CE Mark certified systems, Any base unit that contains a 125VAC/DC Digital Input Electronics module (1C31107G02) with a Differential Digital Input Personality Module (1C31110G02) and interfaces to hazardous voltage (>30 V RMS, 42.4 V peak, or 60 VDC) must include a hazardous voltage warning label (1B30025H01) on that base unit.

Any base unit that contains a 125VAC/DC Digital Input Electronics module (1C31107G02) with a Single-ended Digital Input Personality Module (1C31110G01) and interfaces to hazardous voltage (>30 V RMS, 42.4 V peak, or 60 VDC) must include a hazardous voltage warning label (1B30025H01) on ALL base units on the branch.

This label must be placed in a visible location on the base unit, preferably above the spare fuse location. The project drawings must indicate this.

10.3 MODULE SPECIFIC INFORMATION

10.3.1 EXTERNAL POWER SUPPLIES - SINGLE-ENDED DIGITAL INPUT FRONT END

If the Digital Input subsystem uses the 1C31110G01 Personality module (configured for 16 single-ended inputs), the required voltage source may be obtained from the internal auxiliary power supply (backplane) or it may be obtained from an external power supply.

If an external power supply is used, Using an External Power Supply (see page 539) contains steps to be undertaken before connecting the external power supply to the Digital Input module base unit terminal block.

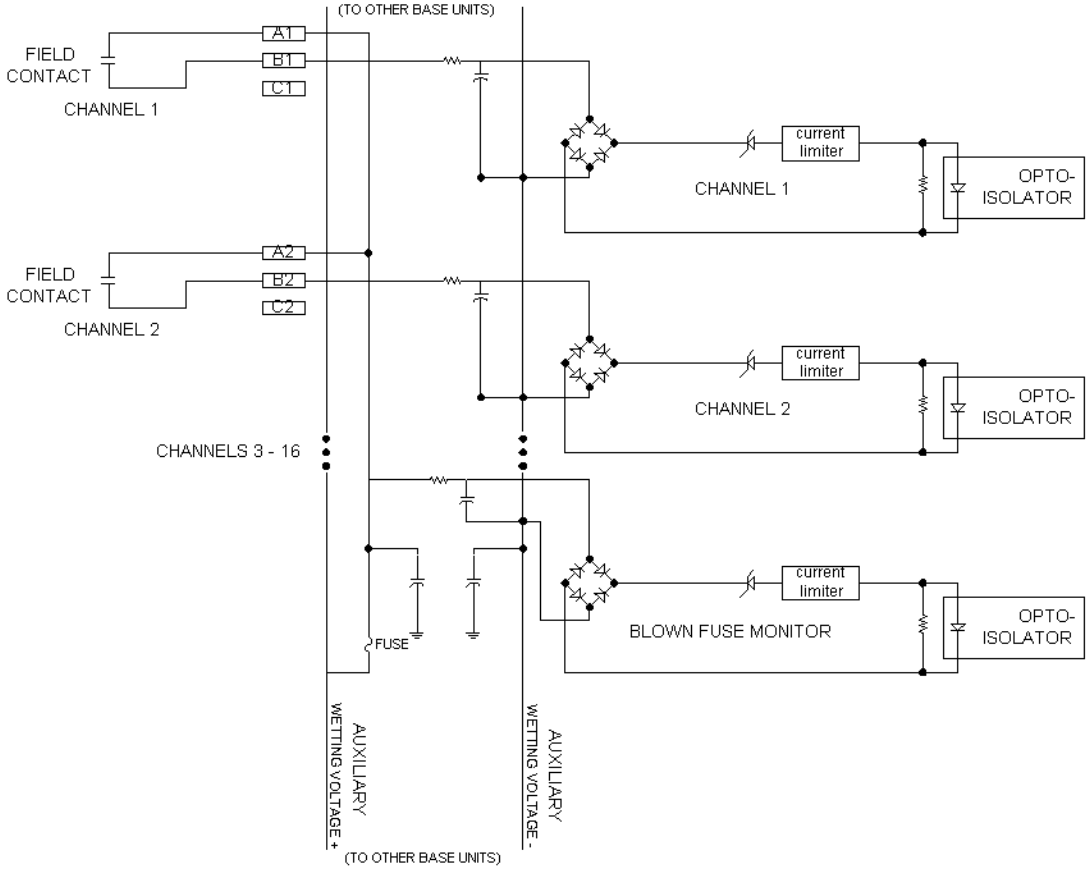


Figure 40: Single-Ended Digital Input Front End

10.3.2 EXTERNAL POWER SUPPLIES - DIFFERENTIAL DIGITAL INPUT FRONT END

If the Digital Input subsystem uses the 1C31110G01 Personality module (configured for 16 single-ended inputs), the required voltage source may be obtained from the internal auxiliary power supply (backplane) or it may be obtained from an external power supply.

If an external power supply is used, Using an External Power Supply (see page 539) contains steps to be undertaken before connecting the external power supply to the Digital Input module base unit terminal block.

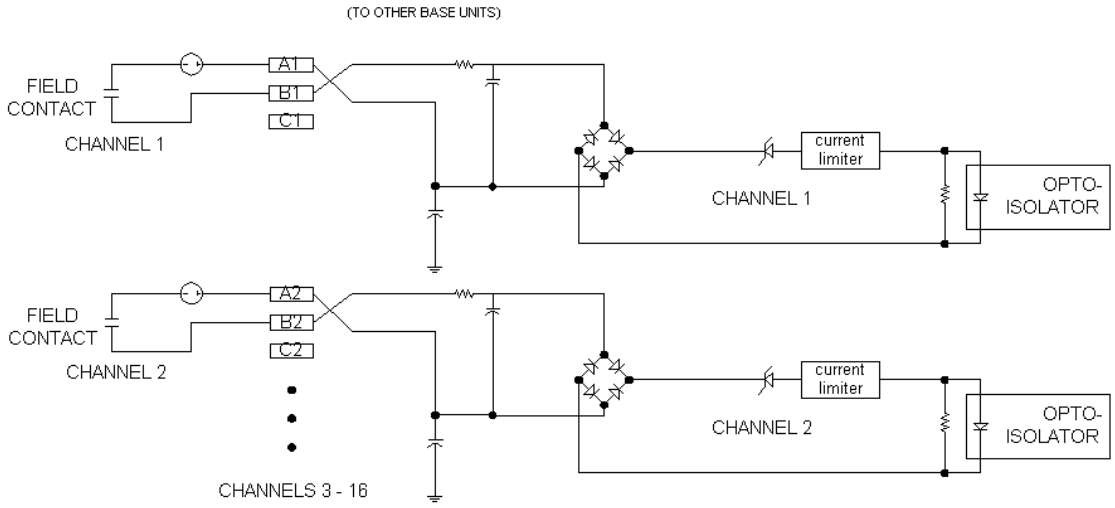


Figure 41: Differential Digital Input Front End

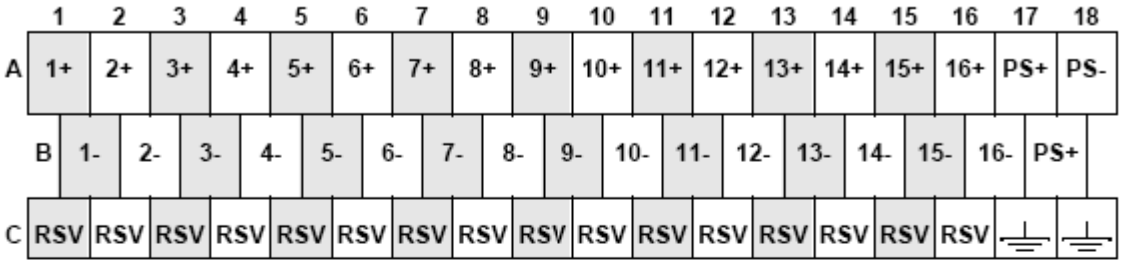
10.4 Wiring Information

10.4.1 Digital Input Terminal Block Wiring Information

Each Personality module has a simplified wiring diagram label on its side, which appears above the terminal block. This diagram indicates how the wiring from the field is to be connected to the terminal block in the base unit.

The diagrams for the digital input Personality modules are illustrated in the following figure. The following table lists and defines the abbreviations used in those diagrams.

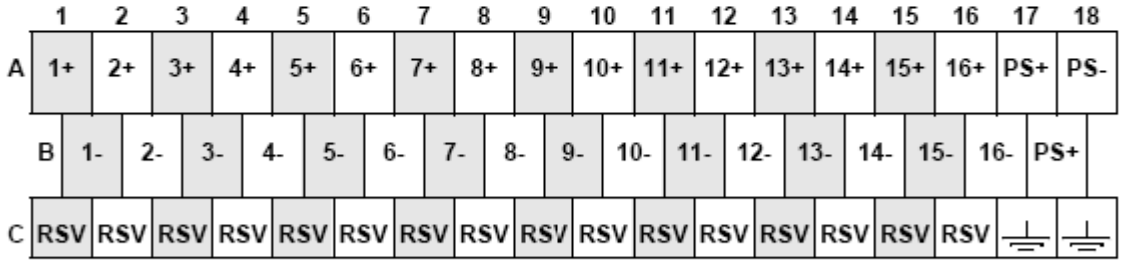
Single-ended Digital Voltage Input: (1C31110G01)



Note

1. Forced signals are present on the reserved (RSV) pins due to backplane connections.

Differential Digital Voltage Inputs: (1C31110G02)



Notes

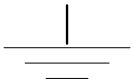
1. Auxiliary power supply return is present on the reserved (RSV) pins due to backplane connections.
2. Each channel has a diode bridge at the front-end; therefore, the inputs to Row A and B are reversible.

   The terminal block label indicates polarity only to be uniform with other terminal block labels where Row A is for high-side (+) signals, and Row B is for return (-) signals.

Figure 42: Terminal Block Connections for the Digital Voltage Input Pmods

Abbreviations Used in Diagrams

Abbreviation	Definition
1+ through 16+	Digital input positive terminal connection
1- through 16-	Digital input negative terminal connection

ABBREVIATION	DEFINITION
	Earth ground terminals
PS+, PS-	Auxiliary Power Supply terminals
RSV	Reserved terminal. No connection allowed on these terminals

*Do **not** use terminal block locations marked RSV.*

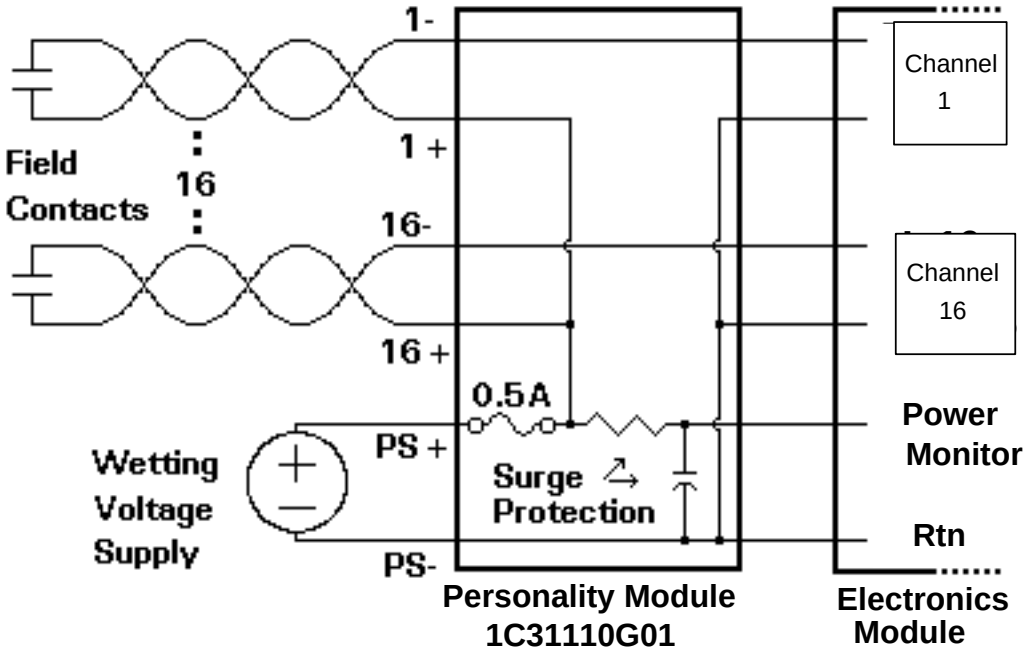
10.4.2 FIELD WIRING CONSIDERATIONS FOR THE DIGITAL INPUT CONFIGURATION

The following maximum resistances of the cable and the interfaced device apply:

- 24/48VDC - 175 KΩ
- 24 VAC - 50 KΩ
- 125 VDC - 250 KΩ
- 125 VAC - 50 KΩ

10.4.3 NON-CE MARK CERTIFIED SYSTEMS

Single-Ended Digital Voltage Inputs



Differential Digital Voltage Inputs

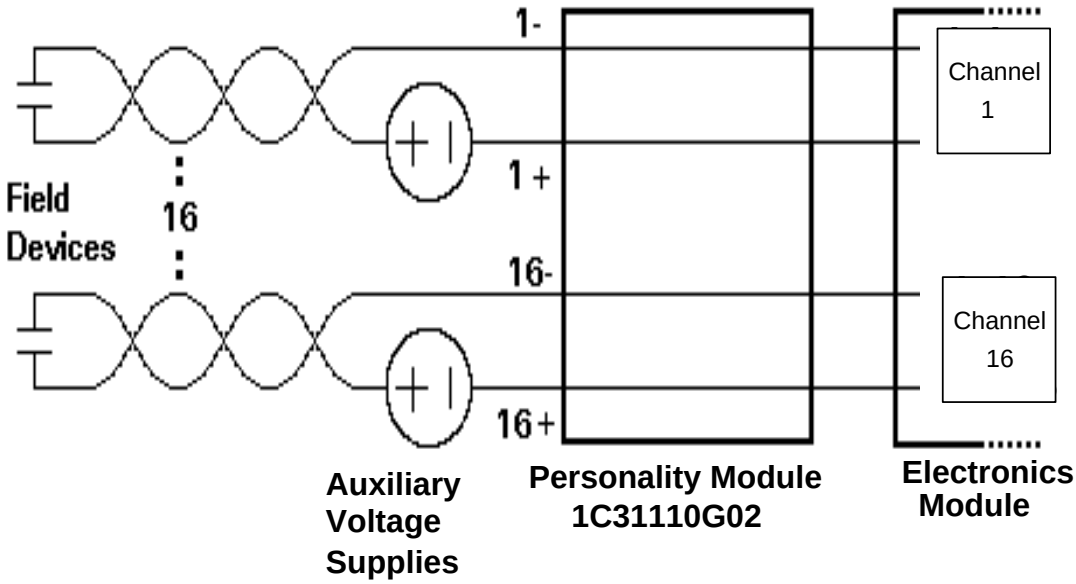
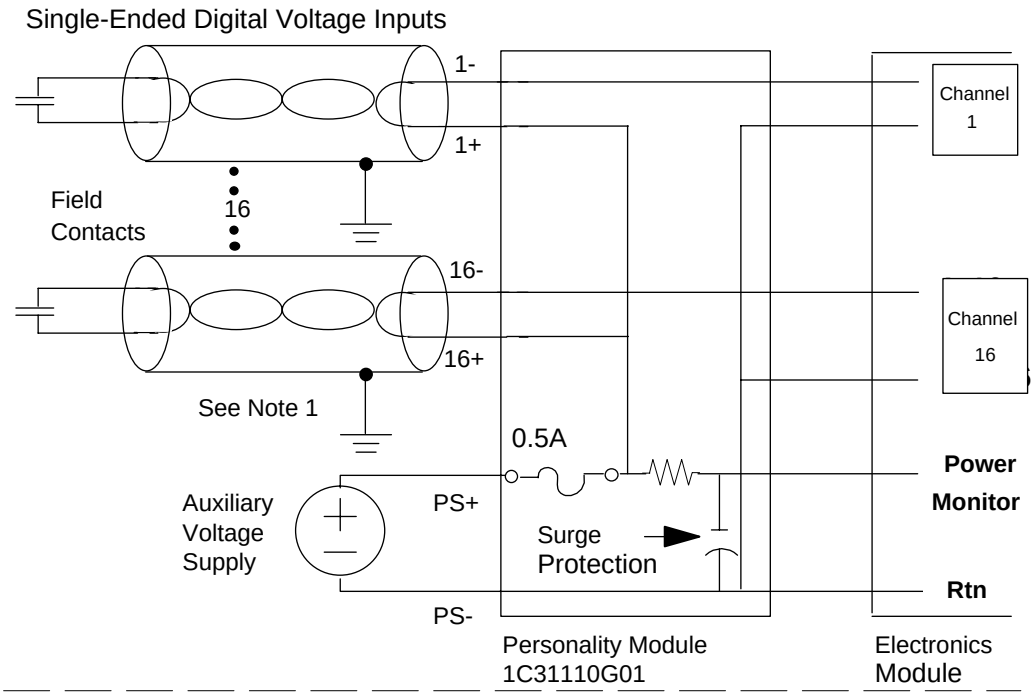
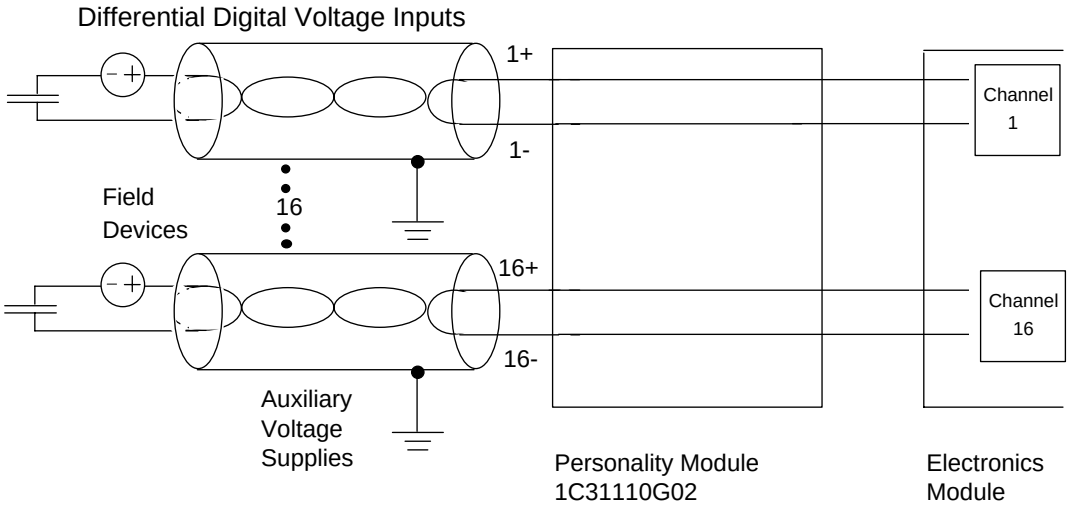


Figure 43: Field Connection for the Digital Input Personality Module (Non-CE Mark)

10.4.4 CE MARK CERTIFIED SYSTEMS





Note

All field wiring must be braid-shielded and grounded at the entry point of the cabinet using the recommended hardware (refer to the applicable "Cable Guidelines" information for your system).

Figure 44: Field Connection for the Digital Input Personality Module (CE Mark)

10.5 Address Location Information

10.5.1 Configuration and Status Register

Word address 13 (D in Hex) is used to configure the module and provide status information to the Controller. The status register can be read by using the Point Information window at an Operator Station (see the Bit Pattern field on the Hardware tab). (See the *Ovation Operator Station User Guide.)*

Digital (and Compact Digital) Input Configuration/Status (Address 13 or D in Hex)

Bit	Data Description - Configuration Register (Write)	Data Description - Status Register (Read)
0	Configure Module (1 = configure; 0 = unconfigure, causing an attention status)	Module Configured (1 = configured; 0 = unconfigured)
1	Force Error (1 = force an attention status to be read by Controller; 0 = no forced error)	Forced error (1 = forced error set by Controller; 0 = no forced error)
2	Not defined	Not defined
3	Not defined	Not defined
4	Not defined	Not defined
5	Not defined	Not defined
6	Blown fuse enable [1] (1 = enable blown fuse detection; 0 = disable blown fuse detection)	Blown fuse enable (1 = blown fuse detection is enabled; 0 = blown fuse detection is disabled)
7	Not defined	Blown fuse (1 = fuse blown or auxiliary voltage not present; 0 = fuse OK and auxiliary voltage present)
8	Not defined	Reserved
9	Reserved	Reserved
10	Not defined	Reserved
11	Not defined	Not defined
12	Not defined	Not defined
13	Not defined	Not defined
14	Not defined	Not defined
15	Not defined	Not defined

[1] Blown Fuse Enable should always be set to “0” on the differential modules (1C31232G02 and 1C31232G03).

Bit definitions for this register are encoded as shown in the table above and described below:

Bit 0: After the Compact Digital Input Module power is cycled, this bit is “0.” A “1” must be written to this bit. If the module is not configured in this manner, an attention status will be sent to the Controller upon an attempt to read the point data.

Bit 1: This bit is “0” after the Compact Digital Input Module power is cycled. If the Controller sets this bit, an attention status is issued.

Bits 2-5, 11-15: These bits are not defined in the Configuration register and will be read as high in the Status register.

Bit 6: The Blown Fuse Enable bit is “0” after the Digital Input module power is cycled. This bit must be set by the Controller for Compact Digital Input Modules, using the single-ended personality module, to detect a blown auxiliary power supply fuse when it reads the Status Register. Blown Fuse Enable should always be set to “0”on the differential modules (1C31232G02 and 1C31232G03). The bit may be read back through the Module Status Register.

Bit 7: This bit is set in the Status Register only if the Blown Fuse Enable bit (6) is set and the single-ended on-board auxiliary supply fuse has blown or the auxiliary voltage is not present. This bit is not defined in the Configuration Register.

Bit 8, 10: These bits are reserved in the Status Register. These bits are not defined in the Configuration Register.

Bit 9: This bit is reserved.

10.6 Diagnostic LEDs

The following table lists the module’s LEDs and describes what they mean when lit.

Digital Input Diagnostic LEDs

LED	Description
P (Green)	Power OK LED. Lit when the +5V power is OK.
C (Green)	Communications OK LED. Lit when the Controller is communicating with the Digital Input module.
E (Red)	External Fault LED. Lit when the Blown Fuse bit (Bit 7) of the Status Register is set. This indicates the field supply fuse is blown or the auxiliary power supply is not present. This LED should never light if the Digital Input module is installed since the Blown Fuse Enable bit (Bit 6) of the Status Register should be set to the inactive state by the Controller.
I (Red)	Internal Fault LED. Lit whenever the Force Error bit (Bit 1) of the Configuration Register (see page 48) is active or when a timeout of the watchdog timer occurs when the Controller stops communicating with the module.
CH1 - CH 16 (Green)	Point Status LED. Lit when the input voltage of the LED’s corresponding channel is greater than the channel’s minimum On Input Voltage.

10.7 SPECIFICATIONS

Electronics Module (1C31107)

Personality Module (1C31110)

Digital Input Module Specifications

DESCRIPTION	VALUE
Number of channels	16
Input range (single-ended or differential) [1]	Refer to the table below.
Propagation delay of contact change of state [2] 24V/48V DC 24VAC 125VDC 125VAC	 1.9 mSec minimum; 25.5 mSec maximum 1.9 mSec minimum; 17.0 mSec maximum 1.9 mSec minimum; 35.0 mSec maximum 1.9 mSec minimum; 40.0 mSec maximum
Cable length (quality is 50pF/ft or better)	1000 feet maximum @ 50pF/ft or better
Diagnostics	Internal module operating faults. Blown fuse detection. [3]
Dielectric isolation: Channel to channel [4] Channel to logic	 1000V DC 500V AC 1000V AC/DC
Module power (drawn from logic supply)	Main: 1.1 W typical, 1.5 W maximum
Operating temperature range	0 to 60°C (32°F to 140°F)
Storage temperature range	-40°C to 85°C (-40°F to 185°F)
Humidity (non-condensing)	0 to 95%

[1] Input range level is dependent on module group.

[2] Does not include cable capacitance.

[3] Blown fuse detection applies to single-ended channel configuration only, where an on-board fuse is provided for the auxiliary power supply.

[4] Channel to channel isolation applies to differential channel configuration only.

Digital Input Ranges

Input Level	On Input Voltage (VDC or VAC RMS)		Off Input Voltage (VDC or VAC RMS)	On Input Current (mA)		Off Input Current (mA)	Power in Front End (Watts)
	Min	Max	Max	Min	Max	Max	Typical
24 VDC	18	60	9	0.6	2.6	0.33	0.75
24 VAC	22	30	7	2.8	5.5	0.6	0.80
48 VDC	18	60	9	0.6	2.6	0.33	1.50
125 VDC	75	132	55	0.65	2.0	0.37	2.80
125 VAC	85	132	40	8.2	13.5	1.9	3.30

SECTION 11

COMPACT DIGITAL INPUT MODULE

IN THIS SECTION

Description *137*
Module Group Information *138*
Module Specific Information *139*
Wiring Information *139*
Address Location Information *147*
Diagnostic LEDs *148*
Specifications *149*

11.1 DESCRIPTION

The Compact Digital Input module contains 16 channels where each channel has voltage level sensing circuitry used to detect whether an input is on or off. The input voltage level sensed by the module is determined by the particular card group of the module.

The module is available for three options:

- 16 isolated differential inputs (unfused) (24/48 VAC/VDC or 125 VAC/VDC).
- 16 single-ended (common return) digital inputs with a common fuse and on-card blown fuse detection for the auxiliary power supply (24/48 VDC).
- 16 individually fused digital inputs using a common power supply. Blown fuse detection is not available with this option (24/48 VAC/VDC or 125 VAC/VDC).

The field side circuitry for the single-ended configuration (see page 141) and for the differential configuration (see page 142). The field side circuitry for the 16 individually fused configuration (see page 143). An input resistor provides the normal mode surge protection and limits the current during normal operation. An opto-isolator provides high dielectric isolation between the field side and the logic or I/O bus side.

The Single-Ended Digital Input configuration has a circuit used to monitor the presence of the auxiliary supply (blown fuse detection). Two cases cause this monitor circuitry to report a blown fuse status and issue an attention status to the Ovation Controller:

- Fuse is blown on the Electronics Module.
- Auxiliary supply level is lower than minimum On Input Voltage.

In addition, a foam insert that includes a wiring diagram is available for placement in the Personality module cavity in the Base Unit in all configurations except the 16 point individually fused option which requires a personality module (5X00034). The compact digital input module is applicable for CE Mark certified systems

Note: *I/O Module General Information (see page 15) contains environmental, installation, wiring, and fuse information for I/O modules.*

11.2 MODULE GROUP INFORMATION

11.2.1 ELECTRONICS MODULES (EMODS)

There are three Electronics module groups for the Compact Digital Input Module:

- **1C31232G01** provides for 24/48 VDC single-ended inputs.
- **1C31232G02** provides for 24/48 VAC/VDC differential inputs and supports the 16 point individually fused option.
- **1C31232G03** provides for 125 VAC/VDC differential inputs and supports the 16 point individually fused option.

11.2.2 PERSONALITY MODULE (PMOD)

There is one Personality module group for the Compact Digital Input Module:

- **5X00034G01** provides for 16 point individual fusing with a common supply.

  This is an optional Personality module that is available for use with the differential input Electronics modules (1C31232G02, 1C31232G03) for applications requiring individual point fusing with a common supply.

Note: *This Personality Module is not available for use with Single Ended Electronics Module 1C3123G01.*

11.2.3 FOAM INSERT

In the event that individual fusing is not required, a foam insert is available that fits into the Personality module cavity in the Base Unit and provides wiring information.

- **1C31238H01**

11.2.4 SUBSYSTEMS, COMPACT DIGITAL INPUT

Compact Digital Input Subsystems [1]

RANGE	CHANNELS	ELECTRONIC MODULE	PERSONALITY MODULE OR CAVITY INSERT [2]
24/48 VDC Single-ended	16	1C31232G01	1C31238H01[1] (Cavity Insert)
24 VAC/VDC 48 VAC/VDC Differential	16	1C31232G02	5X00034G01(Fused Pmod) 1C31238H01[1] (Cavity Insert)
125 VAC/VDC Differential	16	1C31232G03	5X00034G01 (Fused Pmod) 1C31238H01[1] (Cavity Insert)

RANGE	CHANNELS	ELECTRONIC MODULE	PERSONALITY MODULE OR CAVITY INSERT [2]
[1] *All Configurations are CE Mark Certified.*			
[2] This is an insert that fits into the Personality module position and provides a wiring schematic label for the module.			

When the 125VAC/VDC Compact Digital Input Emod (1C31232G03) is used in applications without the Fused Pmod (5X00034G01), additional external fusing or other current limiting devices are recommended on the hazardous inputs to provide additional protection to the external wiring and power source.

11.3 MODULE SPECIFIC INFORMATION

11.3.1 EXTERNAL POWER SUPPLIES

The required voltage source may be obtained from the internal auxiliary power supply (backplane) or it may be obtained from an external power supply when using the following modules:

- **1C31232G01** single-ended Electronic module (configured for 16 single-ended inputs).
- **1C31232G02** or **1C31232G03** 16 point individually fused configuration Electronic modules with 5X00034 Personality module.

If an external power supply is used, Using an External Power Supply (see page 539) contains steps to be undertaken before connecting the external power supply to the Compact Digital Input module base unit terminal block.

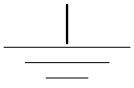
11.4 WIRING INFORMATION

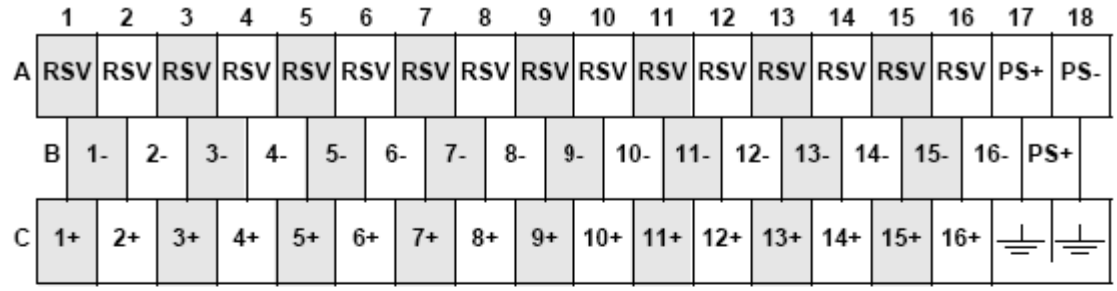
11.4.1 COMPACT DIGITAL INPUT TERMINAL BLOCK WIRING INFORMATION

The available foam insert or Personality module has a simplified wiring diagram label on top, which appears above the terminal block. This diagram indicates how the wiring from the field is to be connected to the terminal block in the base unit.

The following table lists and defines the abbreviations used in the diagram.

Abbreviations Used in Diagrams

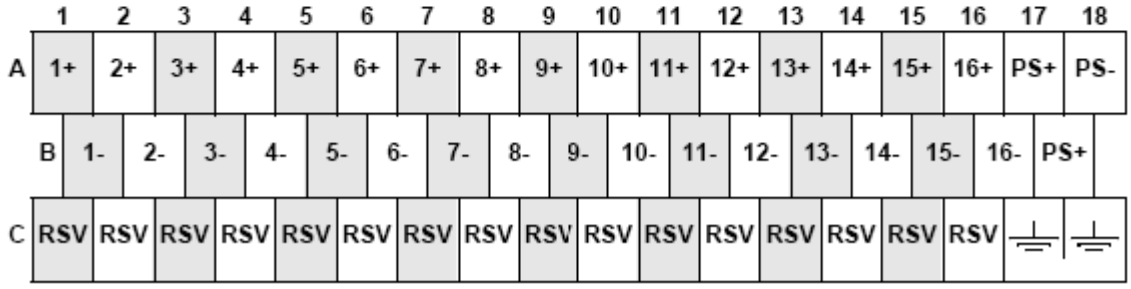
ABBREVIATION	DEFINITION
1+ through 16+	Digital input positive terminal connection
1- through 16-	Digital input negative terminal connection
	Earth ground terminals
PS+, PS-	Auxiliary Power Supply terminals
RSV	Reserved terminal. Do not use.



Configuration Using the Foam Insert (16 point single-ended or differential)

Note

On the differential modules (1C31232G02 and 1C31232G03 only), each channel has a diode bridge at the front-end. Therefore, the inputs to Row B and C are reversible.



Configuration Using the 16 Point Individually Fused Personality Module

Figure 45: Terminal Block Connections for the Compact Digital Input Module

11.4.2 Field Wiring Considerations for the Single-Ended Compact Digital Input Front End

The following maximum resistances of the cable and the interfaced device apply:

- 24/48VDC - 175 KW
- 24 VAC - 50 KW
- 125 VDC - 225 KW
- 125 VAC - 50 KW

CAUTION! For CE Mark certified systems: Any base unit that contains a 125VAC/DC Compact Digital Input Electronics module (1C31232G03) with foam insert (1C31238H01) and interfaces to hazardous voltage (>30 V RMS, 42.4 V peak, or 60 VDC) must include a hazardous voltage warning label (1B30025H01) on that base unit.

Any base unit that contains a 125VAC/DC Compact Digital Input Electronics module (1C31232G03) with the individually fused Personality Module (5X00034G01) and interfaces to hazardous voltage (>30 V RMS, 42.4 V peak, or 60 VDC) must include a hazardous voltage warning label (1B30025H01) on ALL base units on the branch.

This label must be placed in a visible location on the base unit, preferably above the spare fuse location. The project drawings must indicate this.

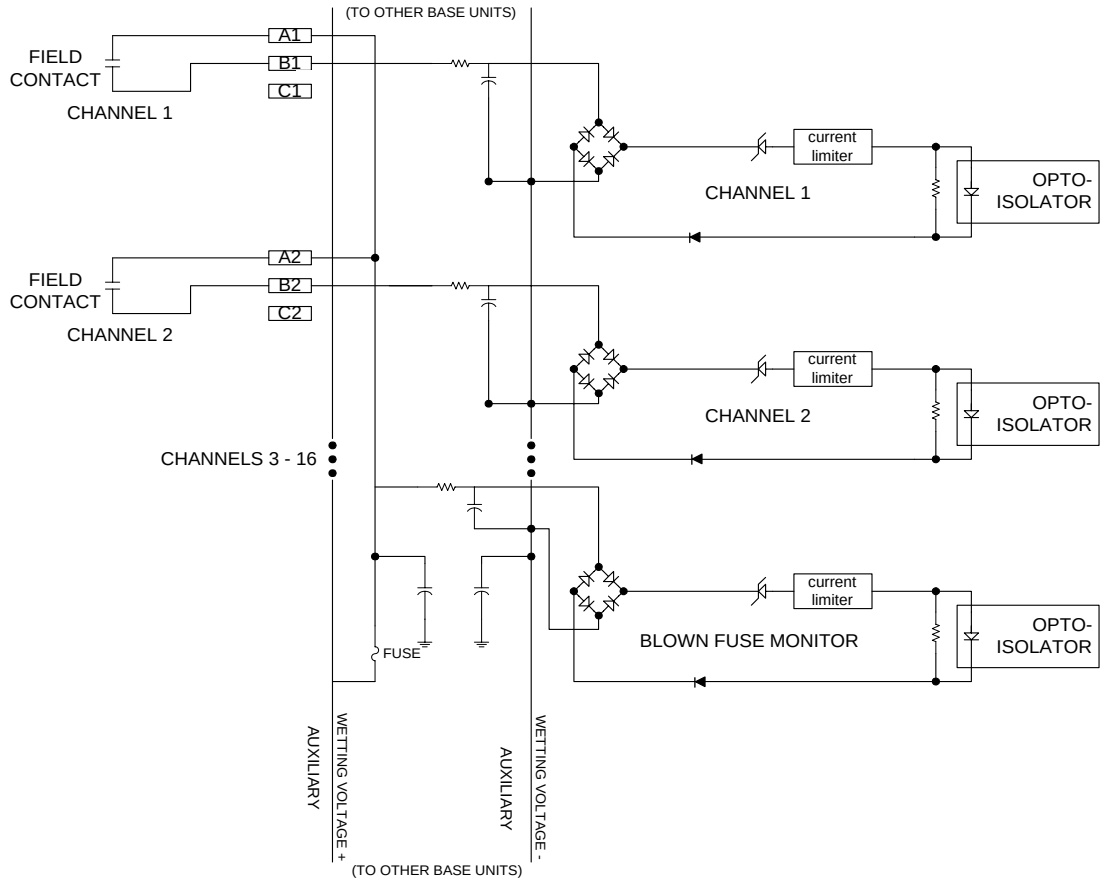


Figure 46: Single-Ended Compact Digital Input Front End

11.4.3 Field Wiring Considerations for the Differential Compact Digital Input Front End

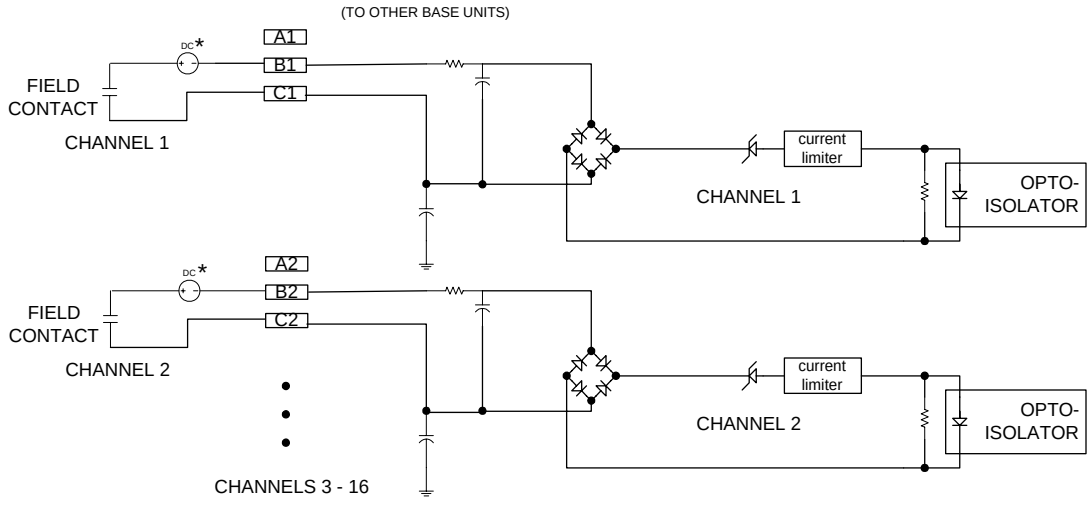
The following maximum resistances of the cable and the interfaced device apply:

- 24/48VDC - 175 KW
- 24 VAC - 50 KW
- 125 VDC - 225 KW
- 125 VAC - 50 KW

CAUTION! (For CE Mark Certified Systems): Any base unit that contains a 125VAC/DC Compact Digital Input Electronics module (1C31232G03) with foam insert (1C31238H01) and interfaces to hazardous voltage (>30 V RMS, 42.4 V peak, or 60 VDC) must include a hazardous voltage warning label (1B30025H01) on that base unit.

Any base unit that contains a 125VAC/DC Compact Digital Input Electronics module (1C31232G03) with the individually fused Personality Module (5X00034G01) and interfaces to hazardous voltage (>30 V RMS, 42.4 V peak, or 60 VDC) must include a hazardous voltage warning label (1B30025H01) on ALL base units on the branch.

This label must be placed in a visible location on the base unit, preferably above the spare fuse location. The project drawings must indicate this.



* Auxiliary power supply may be AC or DC. If a DC supply is used, the polarity can be opposite of what is shown.

Figure 47: Differential Compact Digital Input Front End

11.4.4 Field Wiring Considerations for the 16 Individually Fused Compact Digital Input Front End

The following maximum resistances of the cable and the interfaced device apply:

- 24/48VDC - 175 KW
- 24 VAC - 50 KW
- 125 VDC - 225 KW
- 125 VAC - 50 KW

CAUTION! (For CE Mark Certified Systems): Any base unit that contains a 125VAC/DC Compact Digital Input Electronics module (1C31232G03) with foam insert (1C31238H01) and interfaces to hazardous voltage (>30 V RMS, 42.4 V peak, or 60 VDC) must include a hazardous voltage warning label (1B30025H01) on that base unit.

Any base unit that contains a 125VAC/DC Compact Digital Input Electronics module (1C31232G03) with the individually fused Personality Module (5X00034G01) and interfaces to hazardous voltage (>30 V RMS, 42.4 V peak, or 60 VDC) must include a hazardous voltage warning label (1B30025H01) on ALL base units on the branch.

This label must be placed in a visible location on the base unit, preferably above the spare fuse location. The project drawings must indicate this.

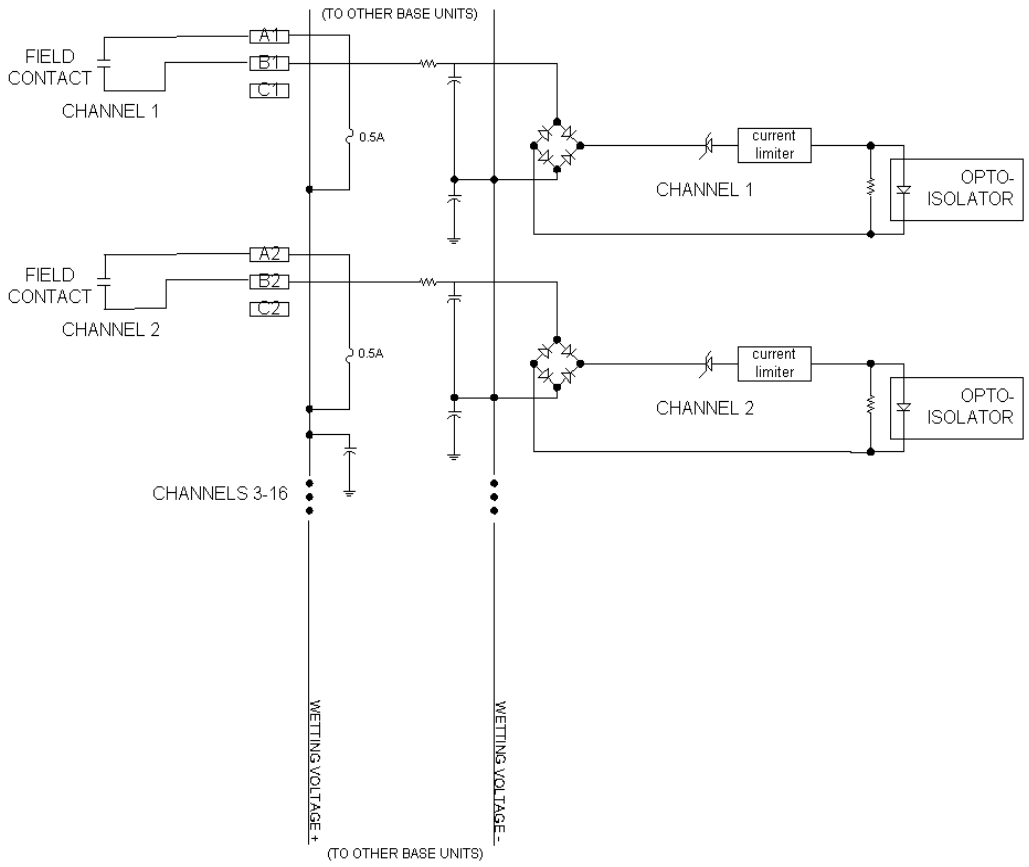


Figure 48: 16 Individually Fused Compact Digital Inputs Front End

11.4.5 NON-CE MARK CERTIFIED SYSTEM

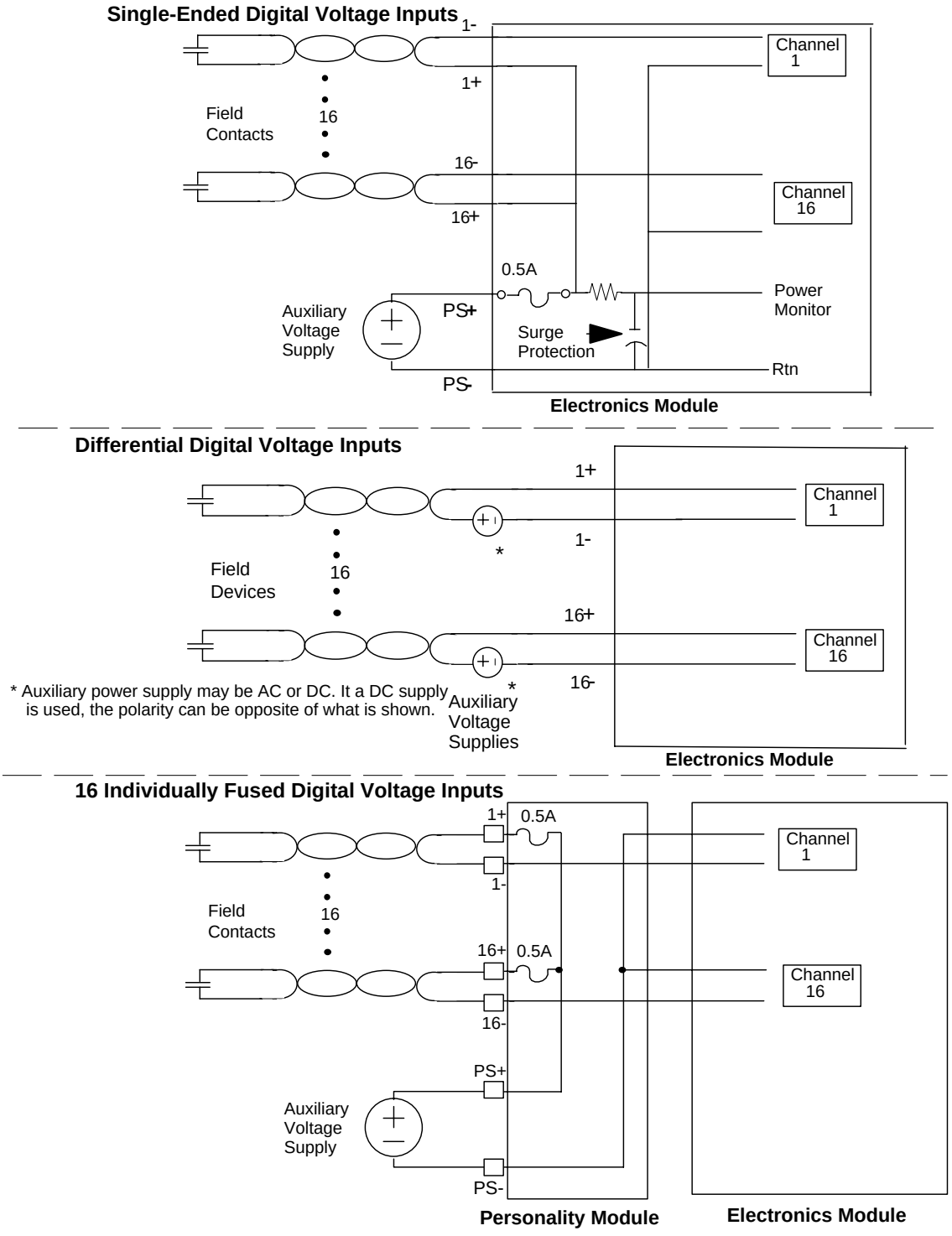


Figure 49: Field Connections for the Compact Digital Input Module (Non-CE Mark)

11.4.6 CE MARK CERTIFIED SYSTEM

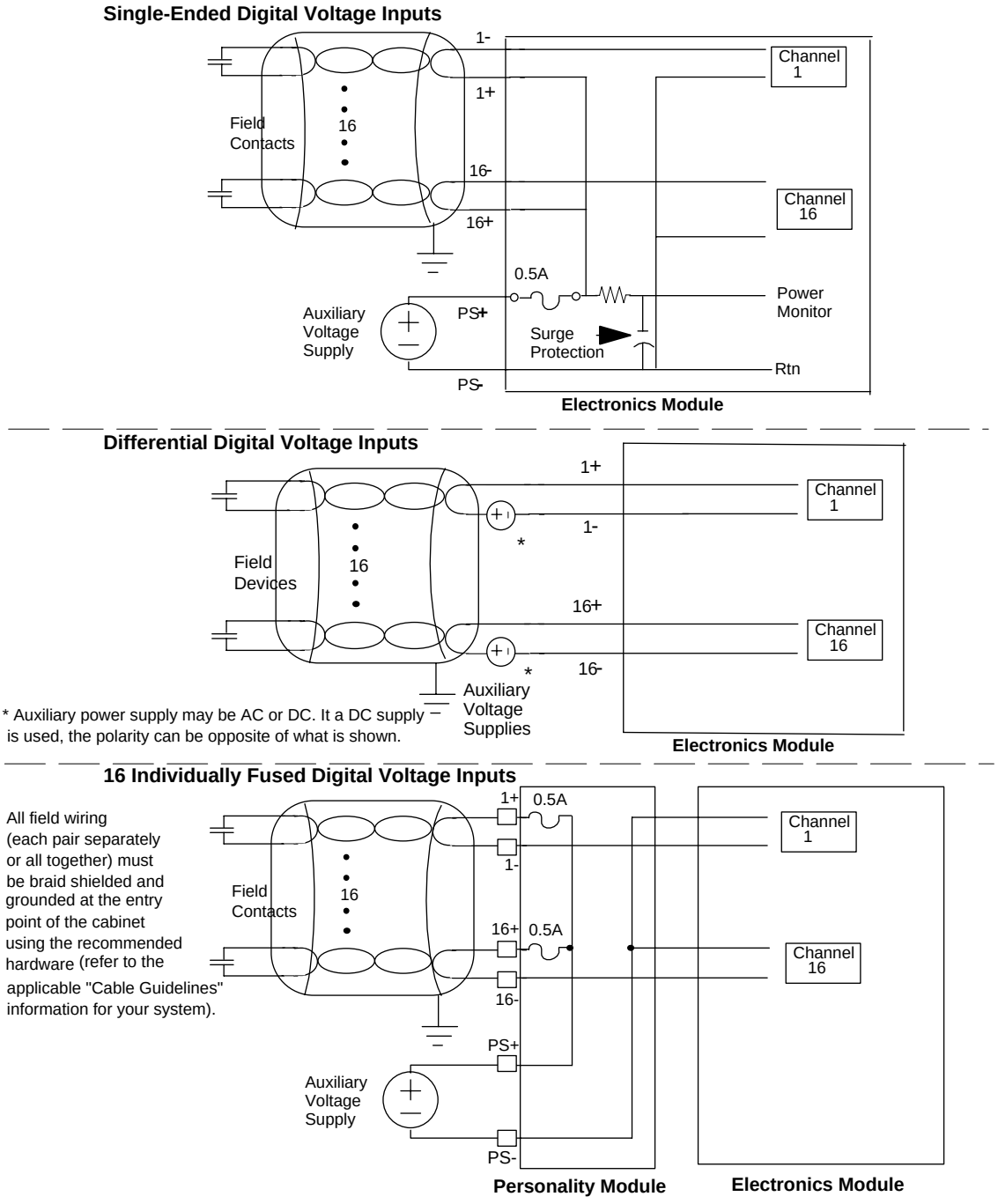


Figure 50: Field Connections for the Compact Digital Input Module (CE Mark)

11.5 Address Location Information

11.5.1 Configuration and Status Register

Word address 13 (D in Hex) is used to configure the module and provide status information to the Controller. The status register can be read by using the Point Information window at an Operator Station (see the Bit Pattern field on the Hardware tab). (See the *Ovation Operator Station User Guide.)*

Digital (and Compact Digital) Input Configuration/Status (Address 13 or D in Hex)

Bit	Data Description - Configuration Register (Write)	Data Description - Status Register (Read)
0	Configure Module (1 = configure; 0 = unconfigure, causing an attention status)	Module Configured (1 = configured; 0 = unconfigured)
1	Force Error (1 = force an attention status to be read by Controller; 0 = no forced error)	Forced error (1 = forced error set by Controller; 0 = no forced error)
2	Not defined	Not defined
3	Not defined	Not defined
4	Not defined	Not defined
5	Not defined	Not defined
6	Blown fuse enable [1] (1 = enable blown fuse detection; 0 = disable blown fuse detection)	Blown fuse enable (1 = blown fuse detection is enabled; 0 = blown fuse detection is disabled)
7	Not defined	Blown fuse (1 = fuse blown or auxiliary voltage not present; 0 = fuse OK and auxiliary voltage present)
8	Not defined	Reserved
9	Reserved	Reserved
10	Not defined	Reserved
11	Not defined	Not defined
12	Not defined	Not defined
13	Not defined	Not defined
14	Not defined	Not defined
15	Not defined	Not defined

[1] Blown Fuse Enable should always be set to “0” on the differential modules (1C31232G02 and 1C31232G03).

Bit definitions for this register are encoded as shown in the table above and described below:

Bit 0: After the Compact Digital Input Module power is cycled, this bit is “0.” A “1” must be written to this bit. If the module is not configured in this manner, an attention status will be sent to the Controller upon an attempt to read the point data.

Bit 1: This bit is “0” after the Compact Digital Input Module power is cycled. If the Controller sets this bit, an attention status is issued.

Bits 2-5, 11-15: These bits are not defined in the Configuration register and will be read as high in the Status register.

Bit 6: The Blown Fuse Enable bit is “0” after the Digital Input module power is cycled. This bit must be set by the Controller for Compact Digital Input Modules, using the single-ended personality module, to detect a blown auxiliary power supply fuse when it reads the Status Register. Blown Fuse Enable should always be set to “0”on the differential modules (1C31232G02 and 1C31232G03). The bit may be read back through the Module Status Register.

Bit 7: This bit is set in the Status Register only if the Blown Fuse Enable bit (6) is set and the single-ended on-board auxiliary supply fuse has blown or the auxiliary voltage is not present. This bit is not defined in the Configuration Register.

Bit 8, 10: These bits are reserved in the Status Register. These bits are not defined in the Configuration Register.

Bit 9: This bit is reserved.

11.6 DIAGNOSTIC LEDS

The following table lists the module’s LEDs and describes what they mean when lit.

Compact Digital Input Diagnostic LEDs

LED	DESCRIPTION
P (Green)	Power OK LED. Lit when the +5V power is OK.
C (Green)	Communications OK LED. Lit when the Controller is communicating with the Compact Digital Input module.
E (Red)	External Fault LED. Lit when the Blown Fuse bit (Bit 7) of the Status Register (see page 133) is set. This indicates the field supply fuse is blown or the auxiliary power supply is not present. This LED should never light if the Compact Digital Input module is installed since the Blown Fuse Enable bit (Bit 6) of the Status Register should be set to the inactive state by the Controller.
I (Red)	Internal Fault LED. Lit whenever the Force Error bit (Bit 1) of the Configuration Register (see page 133) is active or when a timeout of the watchdog timer occurs when the Controller stops communicating with the module.
CH1 - CH 16 (Green)	Point Status LED. Lit when the input voltage of the LED’s corresponding channel is greater than the channel’s minimum On Input Voltage.

11.7 SPECIFICATIONS

Electronics Module (1C31232)

Compact Digital Input Module Specifications

DESCRIPTION	VALUE
Number of channels	16
Input range (single-ended or differential) [1]	Refer to the table below.
Propagation delay of contact change of state [2] 24V/48V DC 24VAC 125VDC 125VAC	 16.0 mSec maximum 14.0 mSec maximum 20.0 mSec maximum 25.0 mSec maximum
Cable length (quality is 50pF/ft or better)	1000 feet maximum @ 50pF/ft or better
Diagnostics	Internal module operating faults. Blown fuse detection. [3]
Dielectric isolation: Channel to channel [4] Channel to logic	 1000 VAC 2000 VAC (differential);1000 VAC (single-ended)
Module power (drawn from logic supply)	Main: 1.1 W typical, 1.5 W maximum
Operating temperature range	0 to 60×C (32×F to 140×F)
Storage temperature range	-40×C to 85×C (-40×F to 185×F)
Humidity (non-condensing)	0 to 95%

[1] Input range level is dependent on module group.

[2] Does not include cable capacitance.

[3] Blown fuse detection applies to single-ended channel configuration only when an on-board fuse is provided for the auxiliary power supply.

[4] Channel to channel isolation applies to differential channel configuration only.

Compact Digital Input Ranges

Input Level	On Input Voltage (VDC or VAC RMS) Min	Max	Off Input Voltage (VDC or VAC RMS) Max	On Input Current (mA) Min	Max	Off Input Current (mA) Max	Power in Front End (Watts) Typical
24 VDC	20	60	9	1.3	2.6	0.33	0.69
24 VAC	22	30	7	2.8	5.5	0.6	0.80
48 VDC	18	60	9	1.3	2.6	0.33	1.75
125 VDC	80	140	55	1.3	2.8	0.33	4.26
125 VAC	85	132	40	8.2	14.0	3.00	5.10

SECTION 12

DIGITAL OUTPUT MODULE

IN THIS SECTION

Description *151*
Module Group Information *151*
Module Specific Information *153*
Wiring Information *164*
Address Location Information *173*
Diagnostic LEDs *175*
Specifications *175*

12.1 DESCRIPTION

The Ovation digital output module provides a means to switch up to 60 VDC at moderate currents (for example, relay coils and lamps). The digital output module contains 16 current sinking transistor outputs capable of switching 60 VDC loads at up to 500mA.

The digital output module provides configurable communication timeout periods and LEDs to indicate the status of each output.

The Digital Output Module is applicable for CE Mark Certified Systems.

Note: *I/O Module General Information (see page 15) contains environmental, installation, wiring, and fuse information for I/O modules.*

12.2 MODULE GROUP INFORMATION

12.2.1 ELECTRONICS MODULE (EMOD)

There is one Electronics module group for the Digital Output Module:

- **1C31122G01** provides for switching 60 VDC loads.

12.2.2 PERSONALITY MODULES (PMODS)

There are three Personality module groups for the Digital Output Module:

- **1C31125G01** is used to interface the digital output module to the field through the terminal blocks.
- **1C31125G02** is used to interface the digital output module to the relay modules when power is supplied locally (from the I/O backplane auxiliary power supply). It can also be used to interface the digital output module to the field through the terminal blocks.
- **1C31125G03** is used to interface the digital output module to the relay modules when power is supplied remotely (from the relay modules). It can also can be used to interface the digital output module to the field through the terminal blocks.

CAUTION! When 1C31125G03 is used, the returns for the remote power supply and the local power supply are connected together. Therefore, to avoid problems with differences in earth ground potentials, ensure that the power supply return lines are earth grounded at only ONE point.

12.2.3 SUBSYSTEMS, DIGITAL OUTPUT

Digital Output Subsystems [1]

DESCRIPTION	CHANNELS	ELECTRONIC MODULE OR PANEL KIT	PERSONALITY MODULE
0-60 VDC Single ended Direct	16	1C31122G01	1C31125G01
Relay Panel Interface:			
Local Power Supply	16	1C31122G01	1C31125G02
Field Power Supply	16	1C31122G01	1C31125G03
Relay Panels:			
Solid State Relay Panel (AC)	16	5A22410G01	
Solid State Relay Panel (DC)	16	5A22410G02	
G2R Relay Panel (Low Power Electro-mechanical)	16	5A22411G01	
KU Relay Panel [2] (High Power Electro-mechanical)	16	5A22412G01, G02, G03	

[1] All configurations are CE Mark certified, except AC/DC Solid State Relay Panels.

[2] Two panels (8 relays each) are included in the KU Relay Panel kit 5A22412G01, G02, and G03.

12.3 Module Specific Information

12.3.1 External Power Supplies

The Digital Output module may obtain voltage from the internal auxiliary power supply (backplane) or from an external power supply.

If an external power supply is used, Using an External Power Supply (see page 539) contains steps to be undertaken before connecting the external power supply to the Digital Output module base unit terminal block. The external power supply DC output voltage level depends on the Digital Output module application.

12.3.2 Relay Panels

Relay panels are used to switch high currents and high voltages as required by various field devices. The Digital Output module interfaces to the relay modules through Groups 2 and 3 of the Personality modules and a standard cable.

The following table provides information about the three standard relay modules.

Relay Contact Ratings must be adhered to when utilizing the Digital Output Relay Panel Assemblies. The application must include external current limiting protection for the Digital Output Relay Panel Assemblies.

Digital Output Relay Panels

Relay Module	CE Mark	Size	Number of Channels	Contact Type	Contact Rating	Input Power	Connect Cable
5A22410G01 Solid State	No	35.86 cm L (14.12 in) 7.75 cm W (3.05 in) 10.46 cm H (4.12 in)	16	Solid State (1 normally open)	3.5 amps @250 VAC at 25 °C 1.65 amps @250 VAC at 60 °C	246mA typ 310mA max @26.4V	5A26148
5A22410G02 Solid State	No	35.86 cm L (14.12 in) 7.75 cm W (3.05 in) 10.46 cm H (4.12 in)	16	Solid State (1 normally open)	1.0 amps @200 VDC at 60 °C	246mA typ 310mA max @26.4V	5A26148

Relay Module	CE Mark	Size	Number of Channels	Contact Type	Contact Rating	Input Power	Connect Cable
5A22411G01 G2R Style (Low Power Electromechanical)	Yes	45.09 cm L (17.75 in) 7.75 cm W (3.05 in) 6.05 cm H (2.38 in)	16	Mechanical (1 Form C)	10 amps @250 VAC 10 amps @30 VDC	453mA typ 610mA max @26.4V	5A26148
5A22412G01 [1] KUEP Style (High Power Electromechanical) Contains two 5A22412H01 panels and 16 4960A71H16 relays.	Yes	49.5 cm L (19.5 in) 7.75 cm W (3.05 in) 9.53 cm H (3.75 in)	16 (using two panels)	Mechanical (2 Form C)	10 amps @250 VAC 3 amps @150 VDC	1.32A typ 1.8A max @26.4V (for 2 relay panels) [2]	5A26149
5A22412G02 [1] KUEP Style (High Power Electro-mechanical) Contains two 5A22412H01 panels and 16 4960A71H05 relays.	Yes	49.5 cm L (19.5 in) 7.75 cm W (3.05 in) 9.53 cm H (3.75 in)	16 (using two panels)	Mechanical (Form X)	10 amps @250 VAC 10 amps @150 VDC	940mA typ 1.27A max @26.4V (for 2 relay panels) [2]	5A26149
5A22412G03 [1] KUEP Style (High Power Electromechanical) Contains two 5A22412H01 panels and up to 16 project specific relays.	Yes	49.5 cm L (19.5 in) 7.75 cm W (3.05 in) 9.53 cm H (3.75 in)	16 (using two panels)	Project Specific	Project Specific	Project Specific	5A26149

[1] Two panels required for 16 outputs.

[2] If one panel is used, half the power is needed.

Solid State Relay Module for DIN Rail Layout (5A22410H01/5A22410H02) (Non CE Mark Certified Systems)

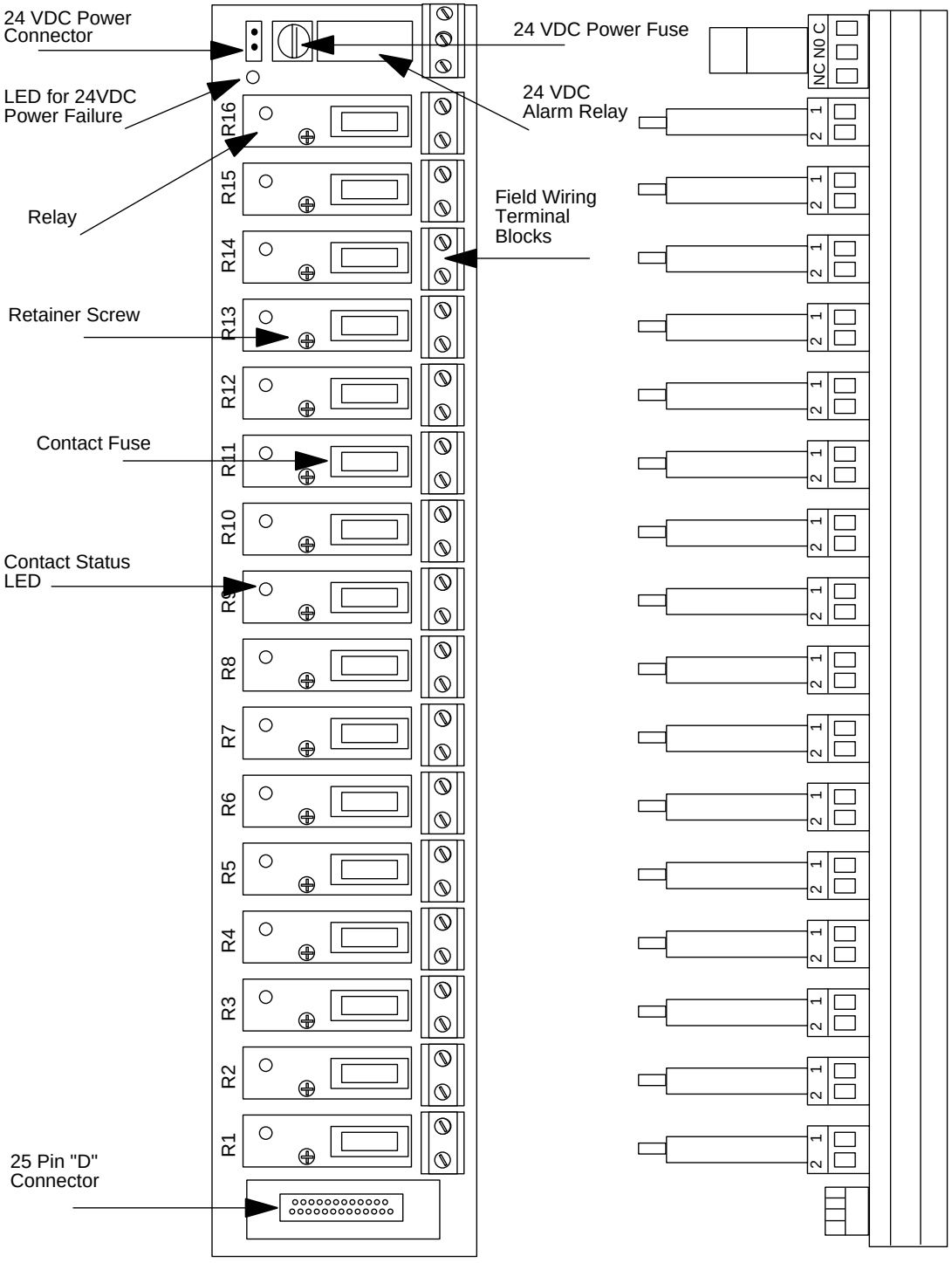


Figure 51: Solid State Relay Module for DIN Rail Layout (5A22410H01/5A22410H02)

Solid State Relay Module for DIN Rail Layout (5A22410H01/5A22410H02) (Non CE Mark Certified Systems)

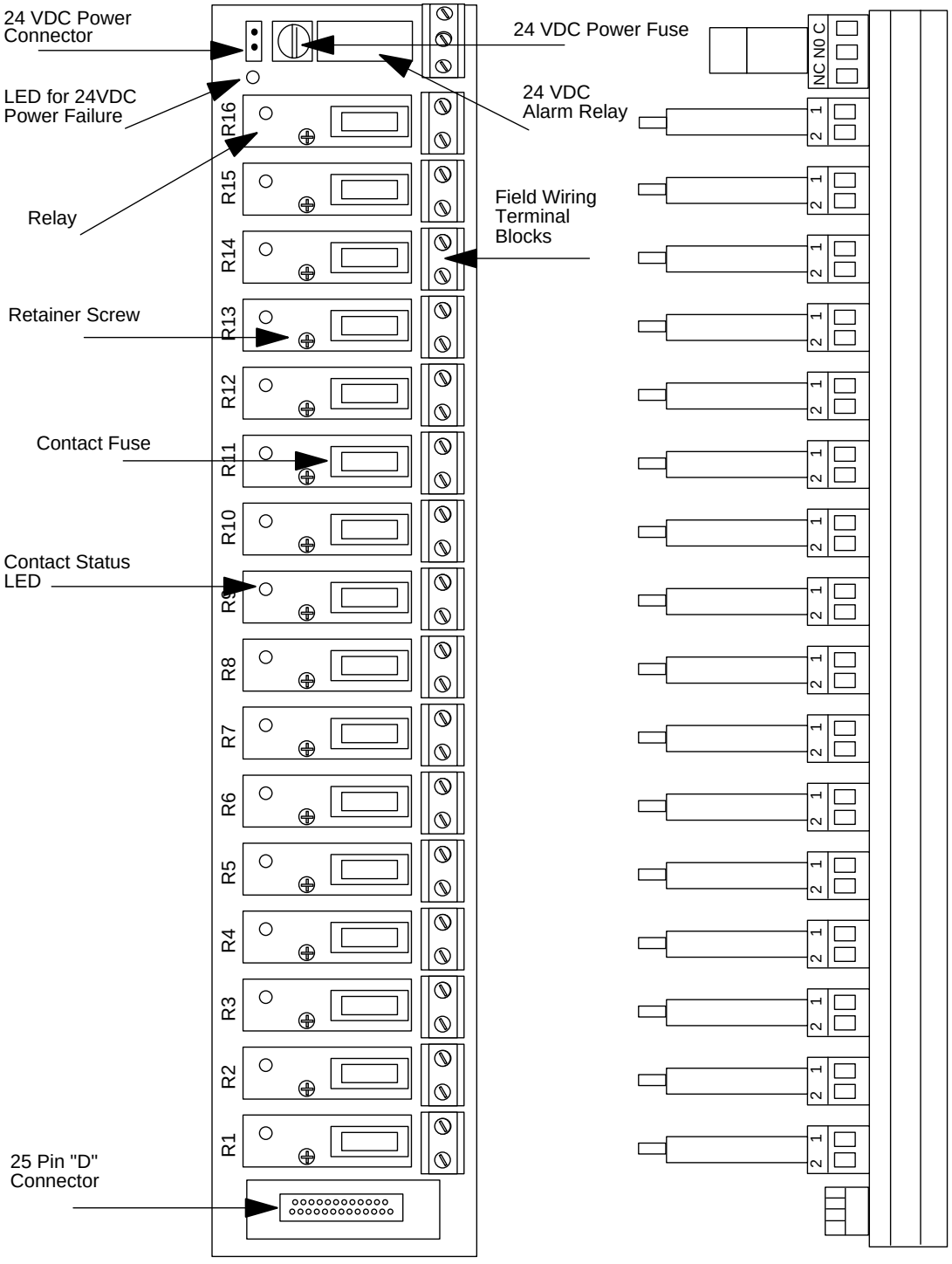


Figure 52: Solid State Relay Module for DIN Rail Layout (5A22410H01/5A22410H02)

Solid State Relay Module Terminations (5A22410H01/5A22410H02) (Non CE Mark Certified Systems)

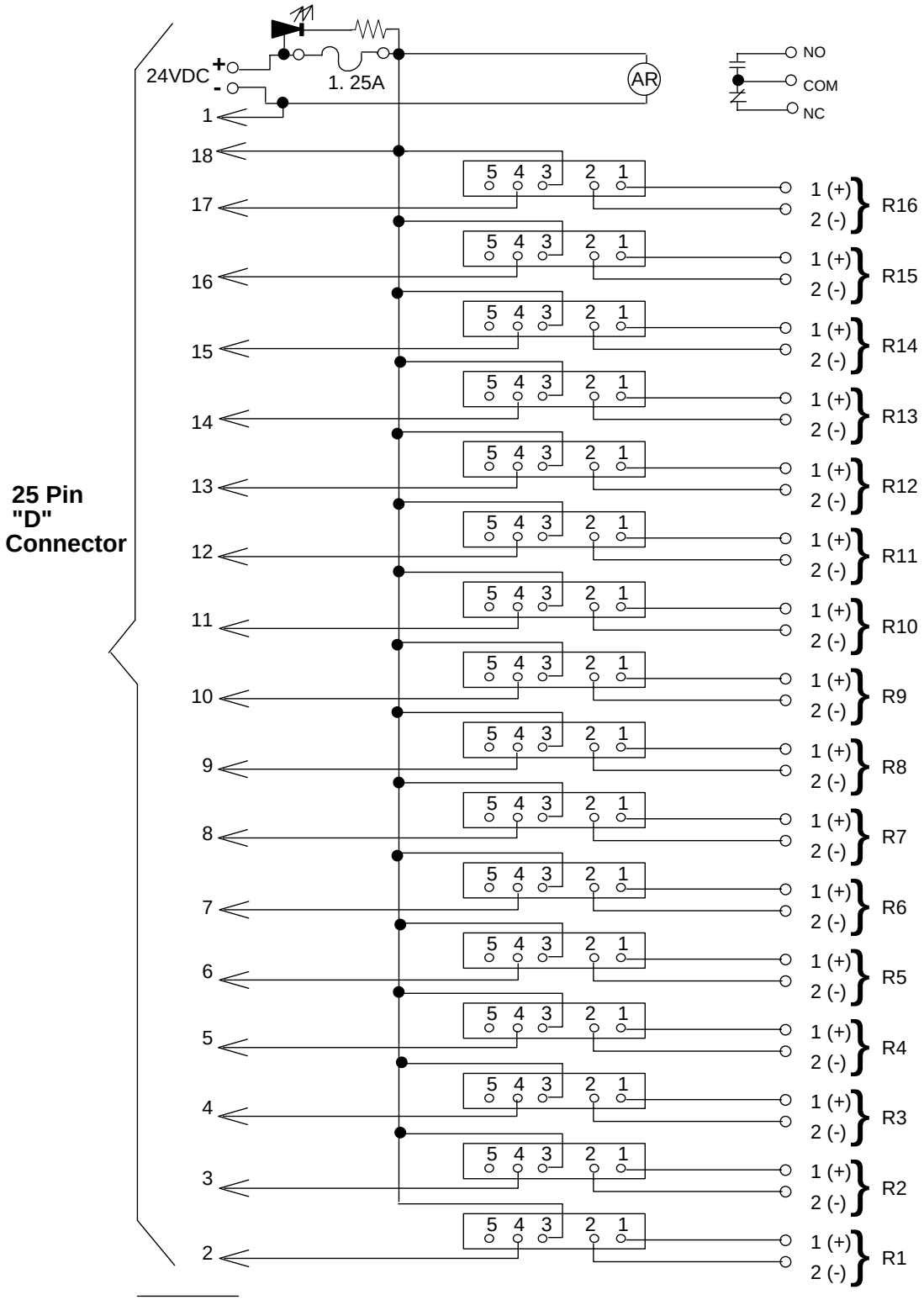


Figure 53: Solid State Relay Module Terminations (5A22410H01/5A22410H02)

G2R Style Relay Module for DIN Rail Layout (5A22411H01)

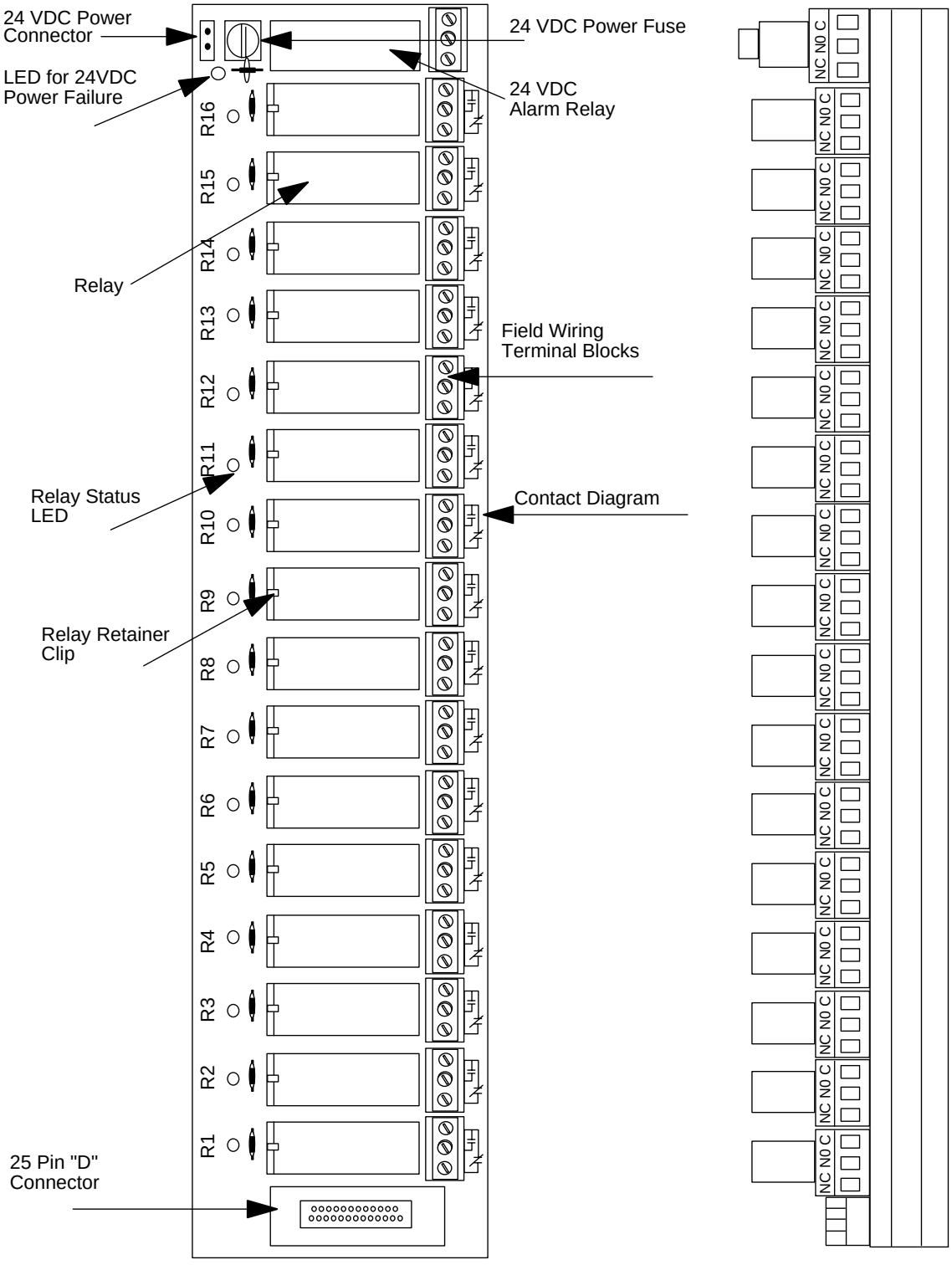


Figure 54: G2R Style Relay Module for DIN Rail Layout (5A22411H01)

G2R Style Relay Module Terminations (5A22411H01)

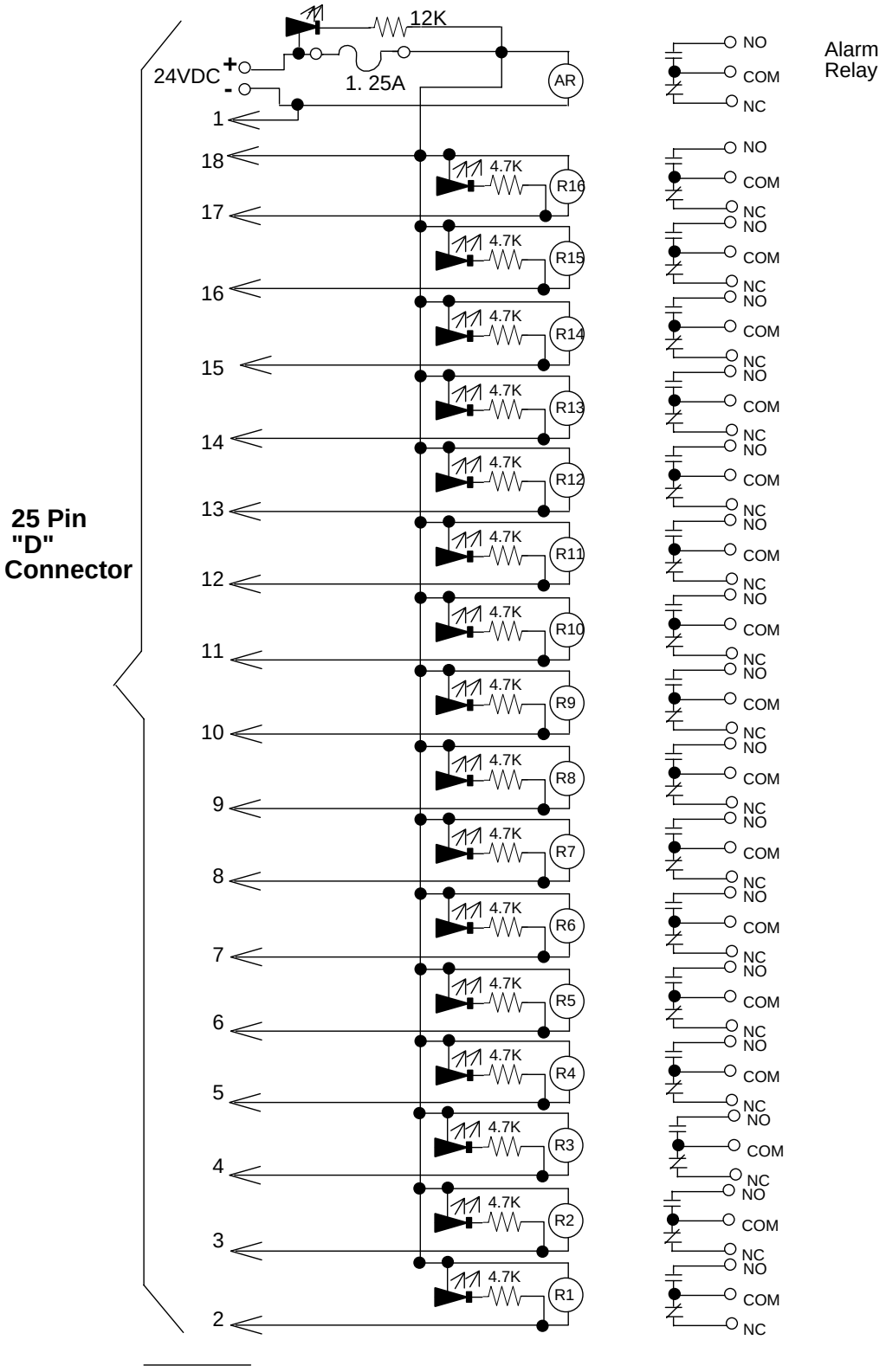


Figure 55: G2R Style Relay Module Terminations (5A22411H01)

KUEP Style Relay Module for DIN Rail Layout (5A22412G01/5A22412G02)

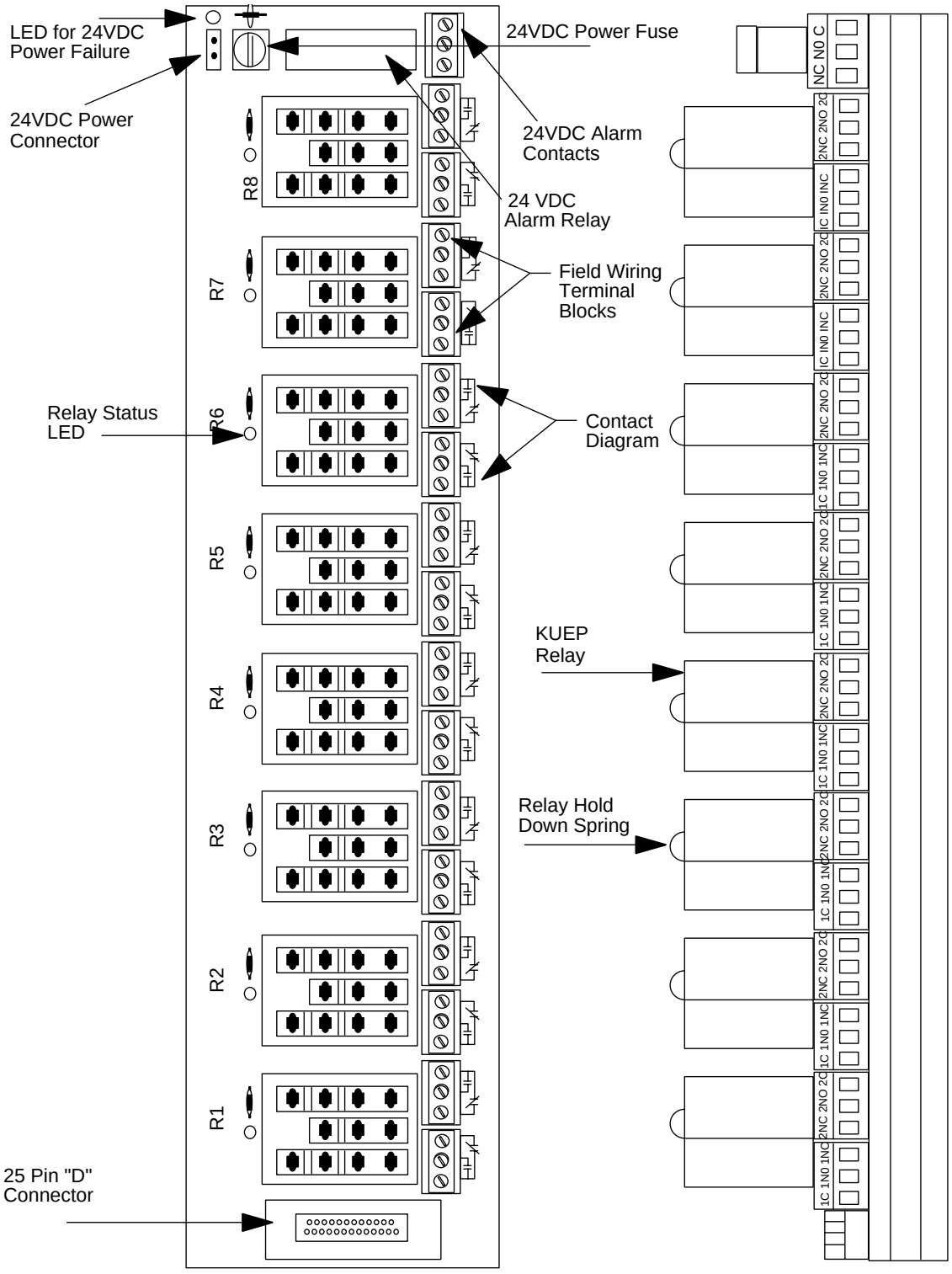


Figure 56: KUEP Style Relay Module for DIN Rail Layout (5A22412G01/

KUEP (2 Form C) Style Relay Module Terminations (5A22412G01)

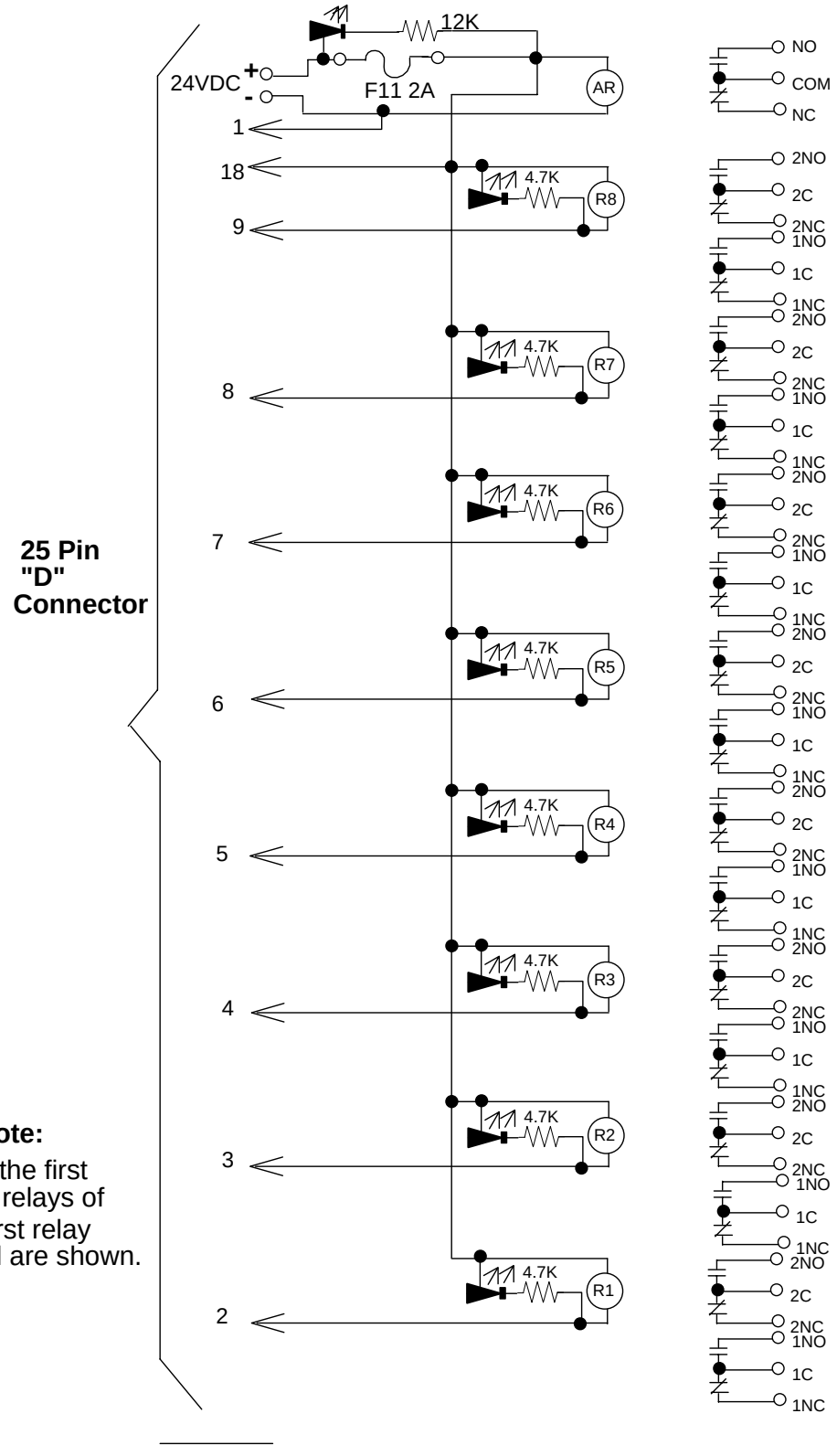


Figure 57: KUEP (2 Form C) Style Relay Module Terminations (5A22412G01)

KUEP (Form X) Style Relay Module Terminations (5A22412G02)

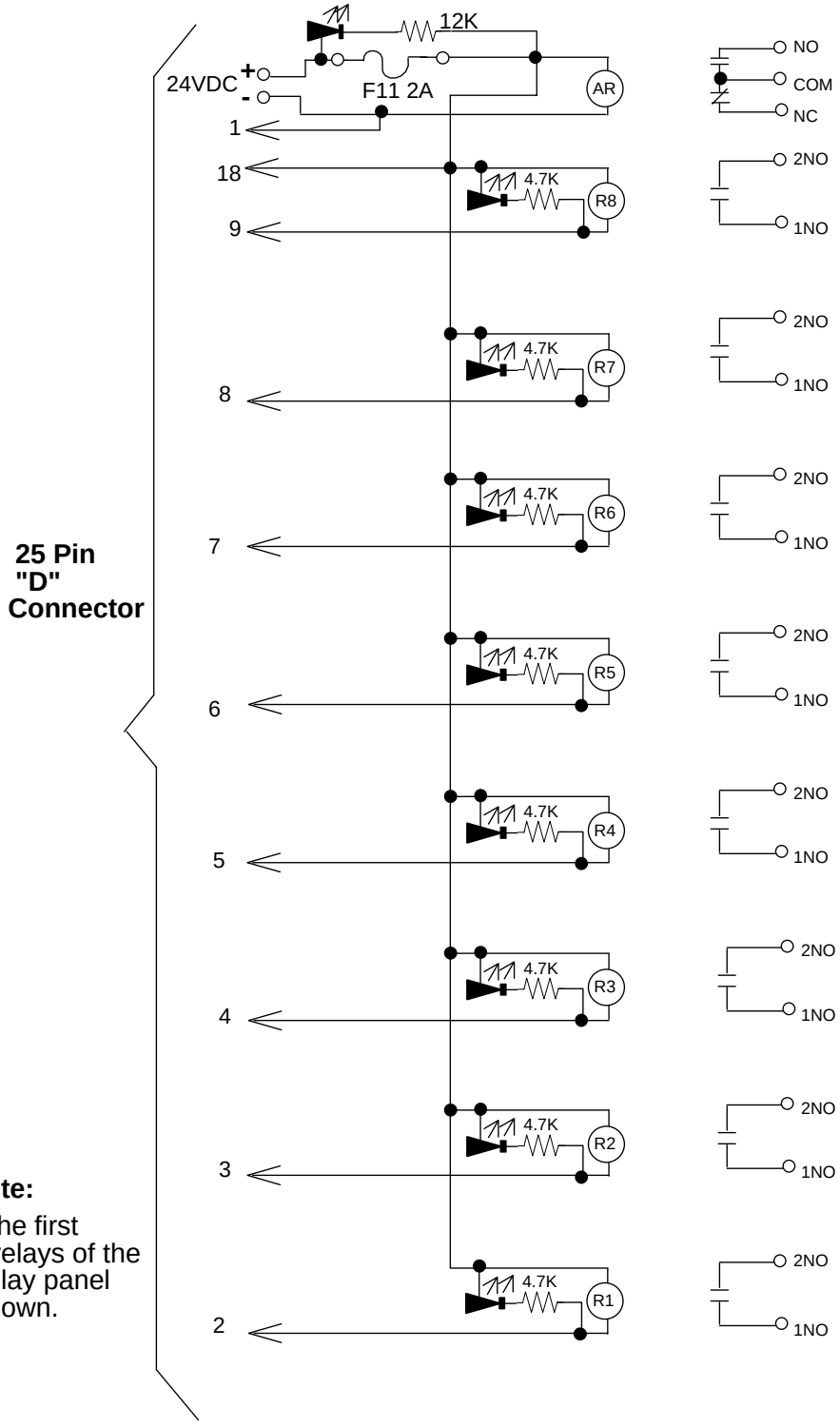


Figure 58: KUEP (Form X) Style Relay Module Terminations (5A22412G02)

12.3.3 BLOWN FUSE DETECTION CIRCUIT

Bit 6 in the status register enables the Controller to monitor the status of the field supply fuse, and it also gives a visual indication of the status via the “EXTERNAL ERROR” LED.

The Controller enables this feature by writing a “1” to Bit 7 of the configuration register. If enabled and the field supply voltage is between 15VDC and 60VDC, the circuit indicates that the field supply fuse is OK by turning OFF the “EXTERNAL ERROR” LED and clearing Bit 6 of the module status register. If enabled and the field supply voltage is less than 0.4VDC, the circuit indicates that the field supply fuse is blown by turning ON the “EXTERNAL ERROR” LED and setting Bit 6 of the module status register.

If the card is operated with a field supply voltage less than 15V, the output circuit will still operate properly. However, the blown fuse detection may not give an accurate indication of the fuse state. In this case, the Controller has the capability to disable the detection circuit by writing a “0” to Bit 7 of the configuration register. When Bit 7 is a “0” the “EXTERNAL ERROR” LED is turned OFF and the blown fuse status bit (Bit 6 of the status register) is cleared which indicates the fuse is OK.

In summary, this feature is specified to operate as follows:

- 15VDC < Field supply voltage < 60VDC => Fuse is OK
- 0.4VDC < Field supply voltage < 15VDC => UNDEFINED
- Field supply voltage < 0.4VDC => Fuse is blown
- After a power-on reset the blown fuse detection circuit is disabled.

12.4 WIRING INFORMATION

12.4.1 DIGITAL OUTPUT TERMINAL BLOCK WIRING INFORMATION

Each Personality module has a simplified wiring diagram label on its side, which appears above the terminal block. This diagram indicates how the wiring from the field is to be connected to the terminal block in the base unit. The diagram for the digital output Personality module is shown in the following figure. The following table lists and defines the abbreviations used in that diagram.

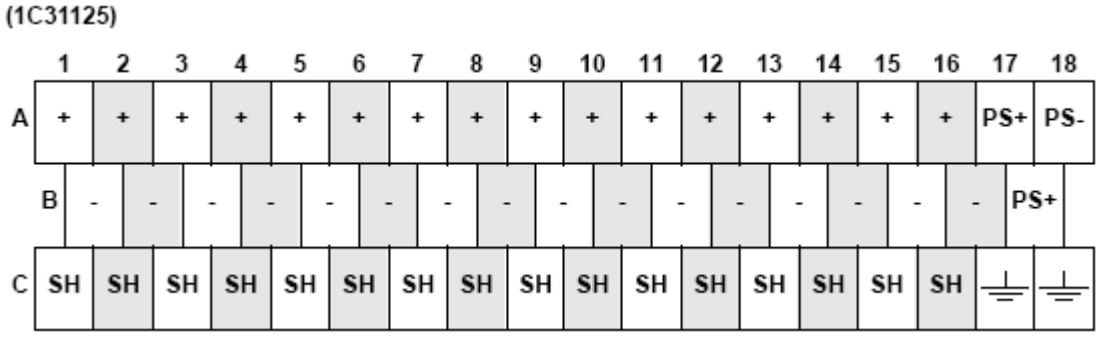
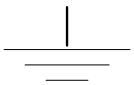


Figure 59: Terminal Block Connections for the Digital Output Personality Modules

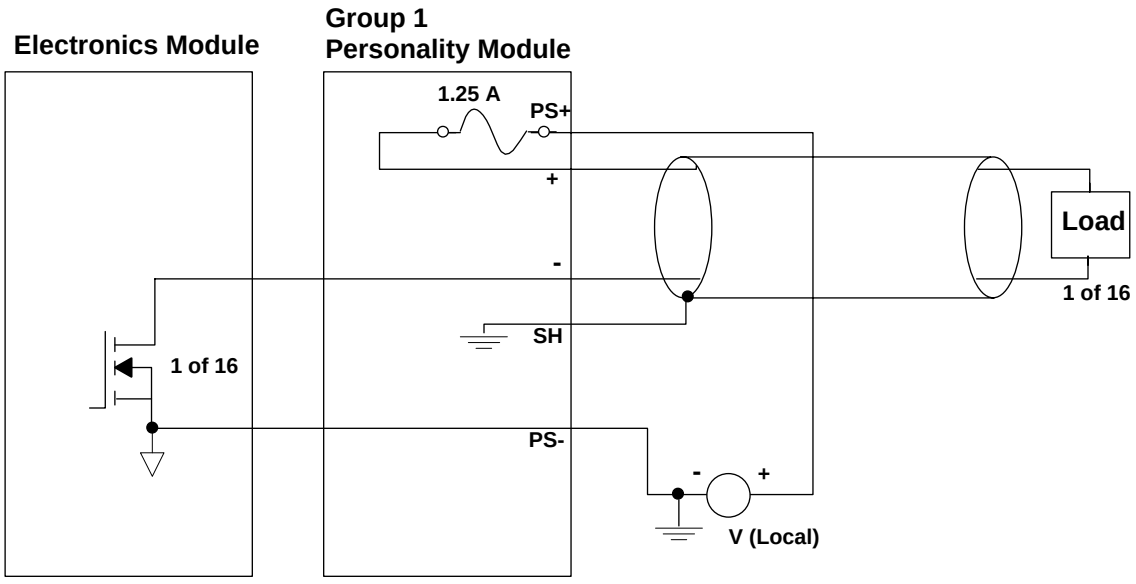
Abbreviations Used in Diagrams

ABBREVIATION	DEFINITION
+	Digital output positive terminal connections
-	Digital output negative terminal connections
	Earth Ground terminals
PS+, PS-	Auxiliary power supply terminals
SH	Shield (non-CE Mark certified systems)

Note: *Do **not** use unmarked terminal block locations.*

*Shield terminals (SH) are **not** connected in CE Mark systems.*

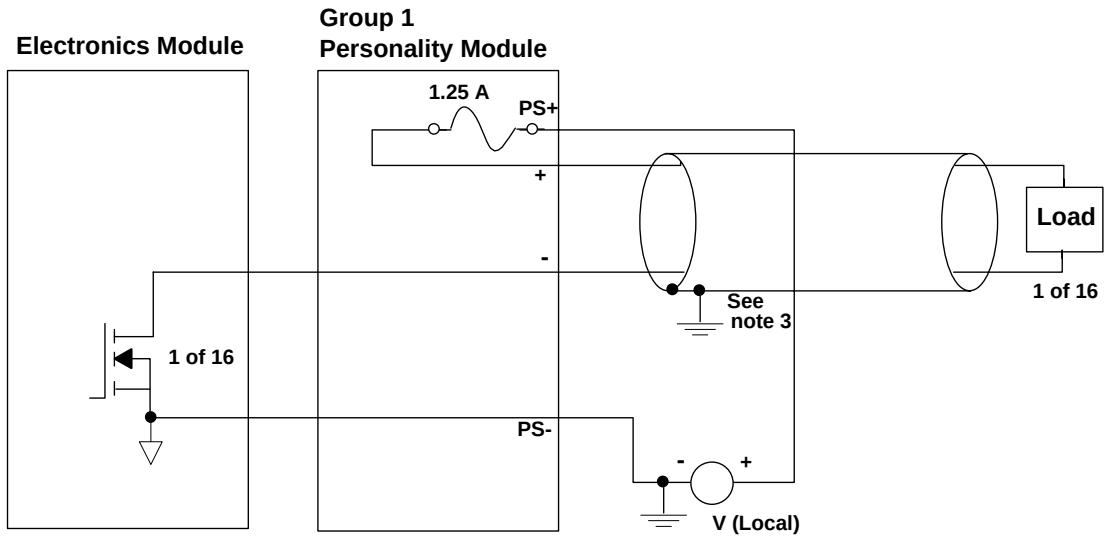
12.4.2 DIGITAL OUTPUT FIELD CONNECTION WIRING DIAGRAMS



Notes

1. V (Local) is the I/O backplane auxiliary power supply.
2. Shielded cables are required for IEC 801-5 compliance.

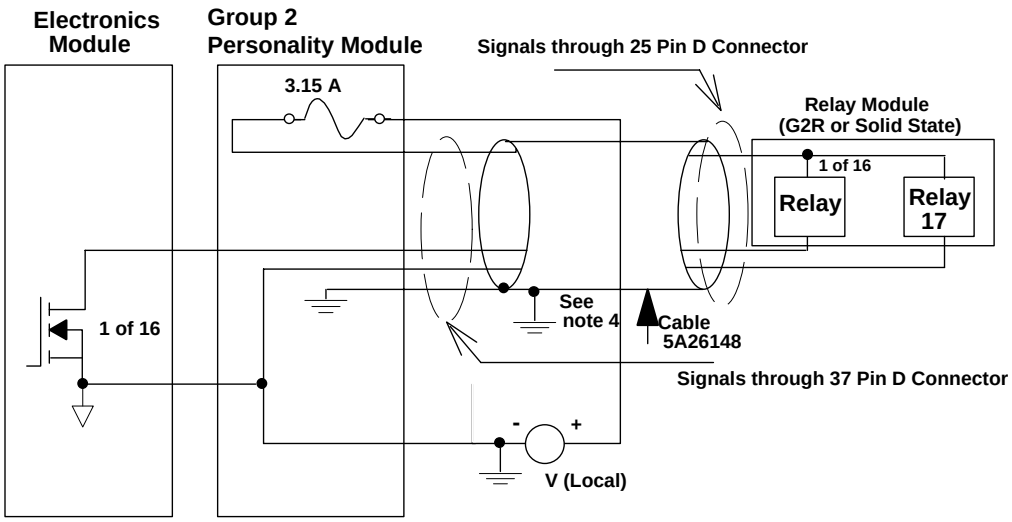
Figure 60: Field Connection for the Digital Output Personality Module (Group 1) (Non-CE Mark Certified Systems)



Notes

1. V (Local) is the I/O backplane auxiliary power supply.
2. Shielded cables are required for IEC 801-5 compliance.
3. All field wiring must be braid shielded and grounded at the entry point of the cabinet using the recommended hardware (see the appropriate "Cable Guidelines" information for your system).

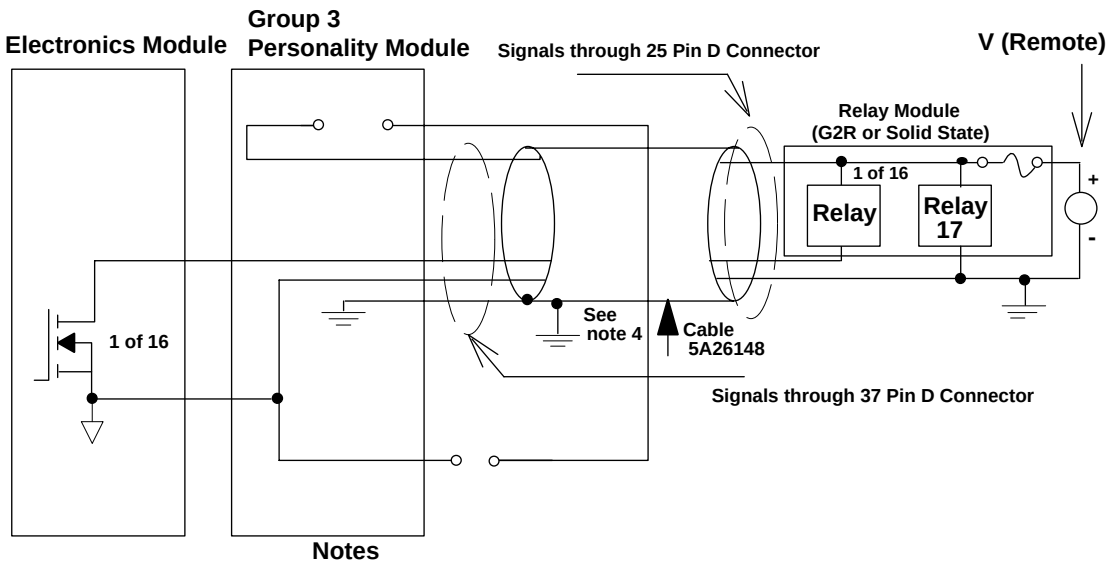
Figure 61: Field Connection for the Digital Output Personality Module (Group 1) (CE Mark Certified System)



Notes

1. V (Local) is the I/O backplane auxiliary power supply.
2. Shielded cables are required for IEC 801-5 compliance.
3. Relay 17 is used to indicate the status of the power supply.
4. For CE Mark certified systems where cable 5A26148 exits the cabinet or a suited set of EMC cabinets: The cable shield must be grounded at the entry point of the cabinet using the recommended hardware (see the appropriate "Cable Guidelines" information for your system).
5. Solid State Relay Configurations not CE Mark Certified.

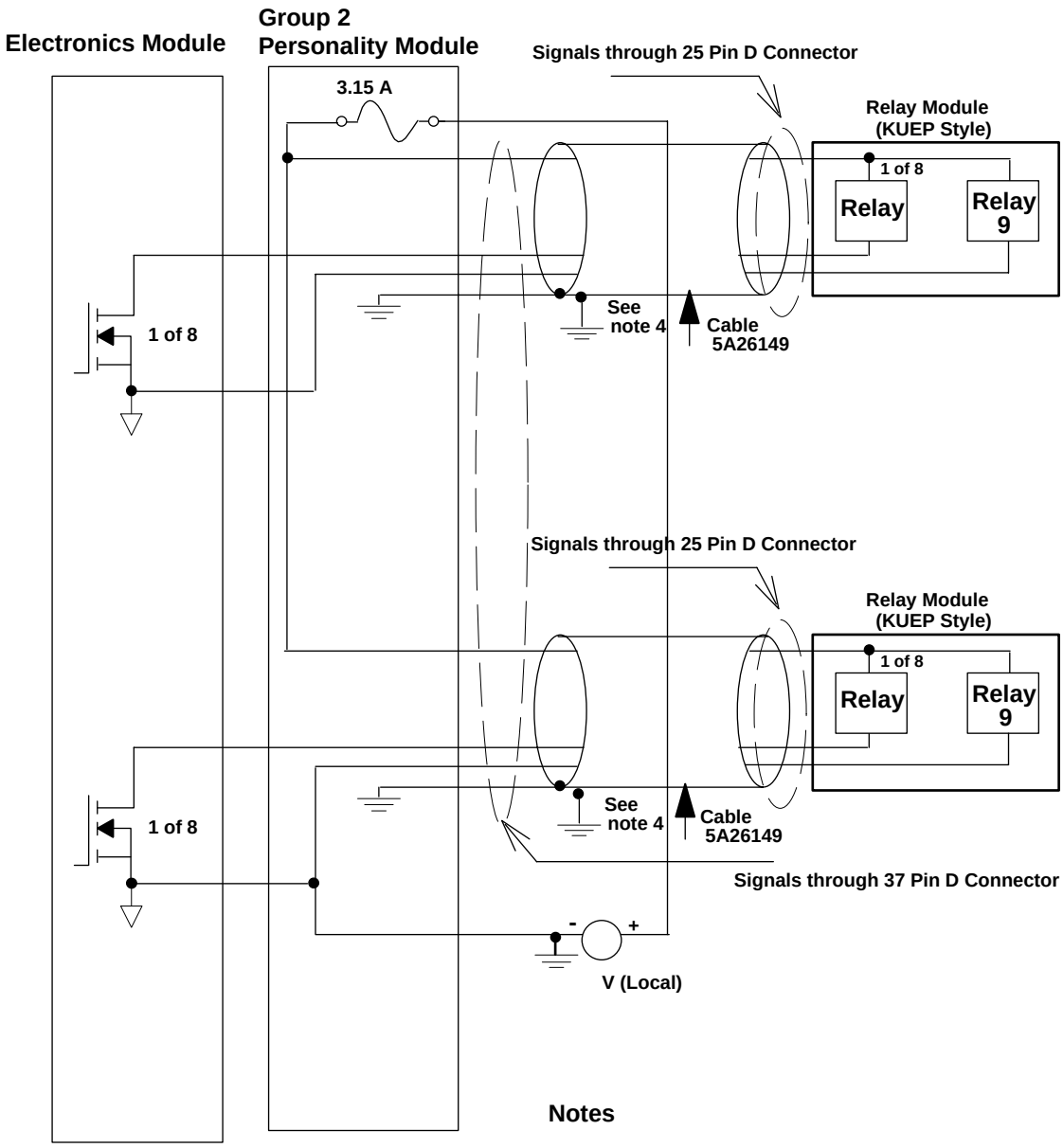
Figure 62: Digital Output Module to Relay Module (G2R or Solid State) Locally Powered



Notes

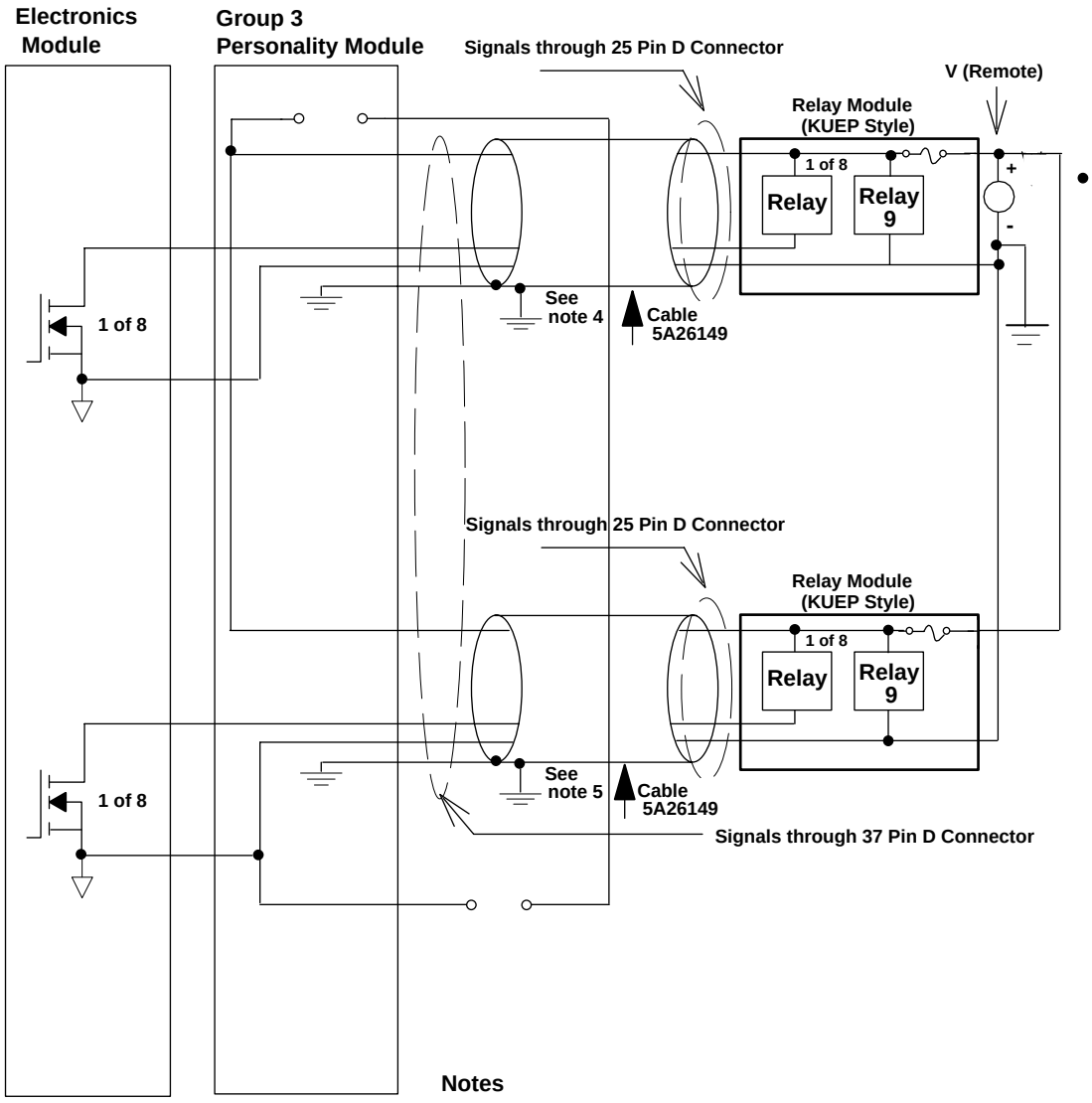
1. V (Remote) is a supply provided via the relay module.
2. Shielded cables are required for IEC 801-5 compliance.
3. Relay 17 is used to indicate the status of the power supply.
4. For CE Mark certified systems where cable 5A26148 exits the cabinet or a suited set of EMC cabinets: The cable shield must be grounded at the entry point of the cabinet using the recommended hardware (see the appropriate "Cable Guidelines" information for your system).
5. Solid State Relay Configurations not CE Mark Certified.

Figure 63: Digital Output Module to Relay Module (G2R or Solid State)



1. V (Local) is the I/O backplane auxiliary power supply.
2. Shielded cables are required for IEC 801-5 compliance.
3. Relay 9 is used to indicate the status of the power supply.
4. For CE Mark certified systems where cable 5A26149 exits the cabinet or a suited set of EMC cabinets: The cable shield must be grounded at the entry point of the cabinet using the recommended hardware (see the appropriate "Cable Guidelines" information for your system).

Figure 64: Digital Output Module to Relay Module (KUEP Style) Locally Powered (Non-CE and CE Mark)



1. V (Remote) is a supply provided via the relay module.
2. Shielded cables are required for IEC 801-5 compliance.
3. Relay 9 is used to indicate the status of the power supply.
4. For CE Mark certified systems where cable 5A26149 exits the cabinet or a suited set of EMC cabinets: The cable shield must be grounded at the entry point of the cabinet using the recommended hardware (see the appropriate "Cable Guidelines" information for your system).

Figure 65: Digital Output Module to Relay Module (KUEP Style) Remotely Powered (Non-CE and CE Mark)

12.4.3 RELAY PANEL APPLICATION DIAGRAMS

The following figures illustrate three types of applications for relay panels.

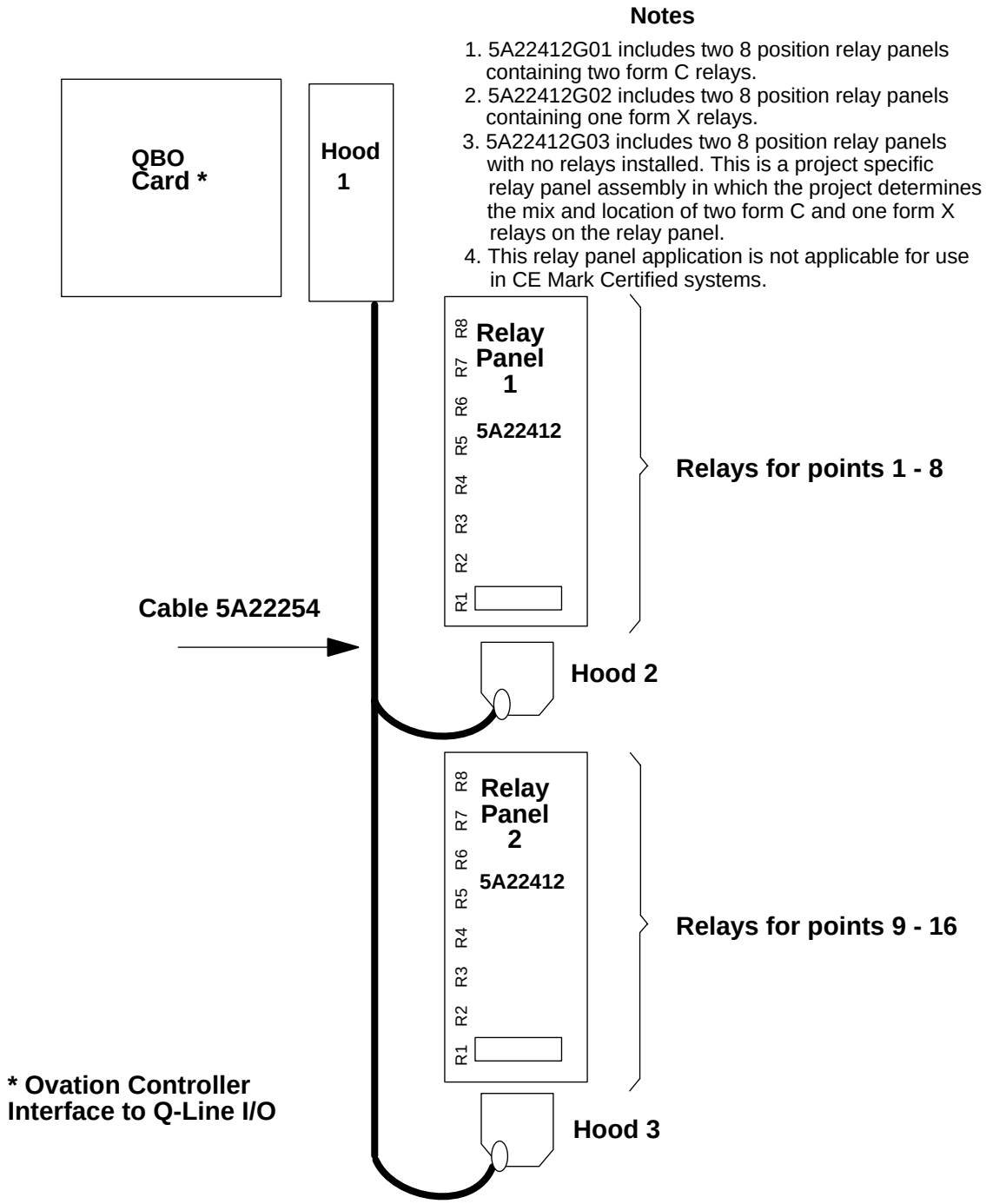

Notes
1. 5A22412G01 includes two 8 position relay panels containing two form C relays.
2. 5A22412G02 includes two 8 position relay panels containing one form X relays.
3. 5A22412G03 includes two 8 position relay panels with no relays installed. This is a project specific relay panel assembly in which the project determines the mix and location of two form C and one form X relays on the relay panel.
4. This relay panel application is not applicable for use in CE Mark Certified systems.
QBO Card *
Hood 1
R8
R7
R6
R5
R4
R3
R2
R1
Relay Panel 1
5A22412
Relays for points 1 - 8
Cable 5A22254
Hood 2
Relay Panel 2
5A22412
Relays for points 9 - 16
* Ovation Controller Interface to Q-Line I/O
Hood 3

Figure 66: Relay Panels to Q-Line (QBO Card)

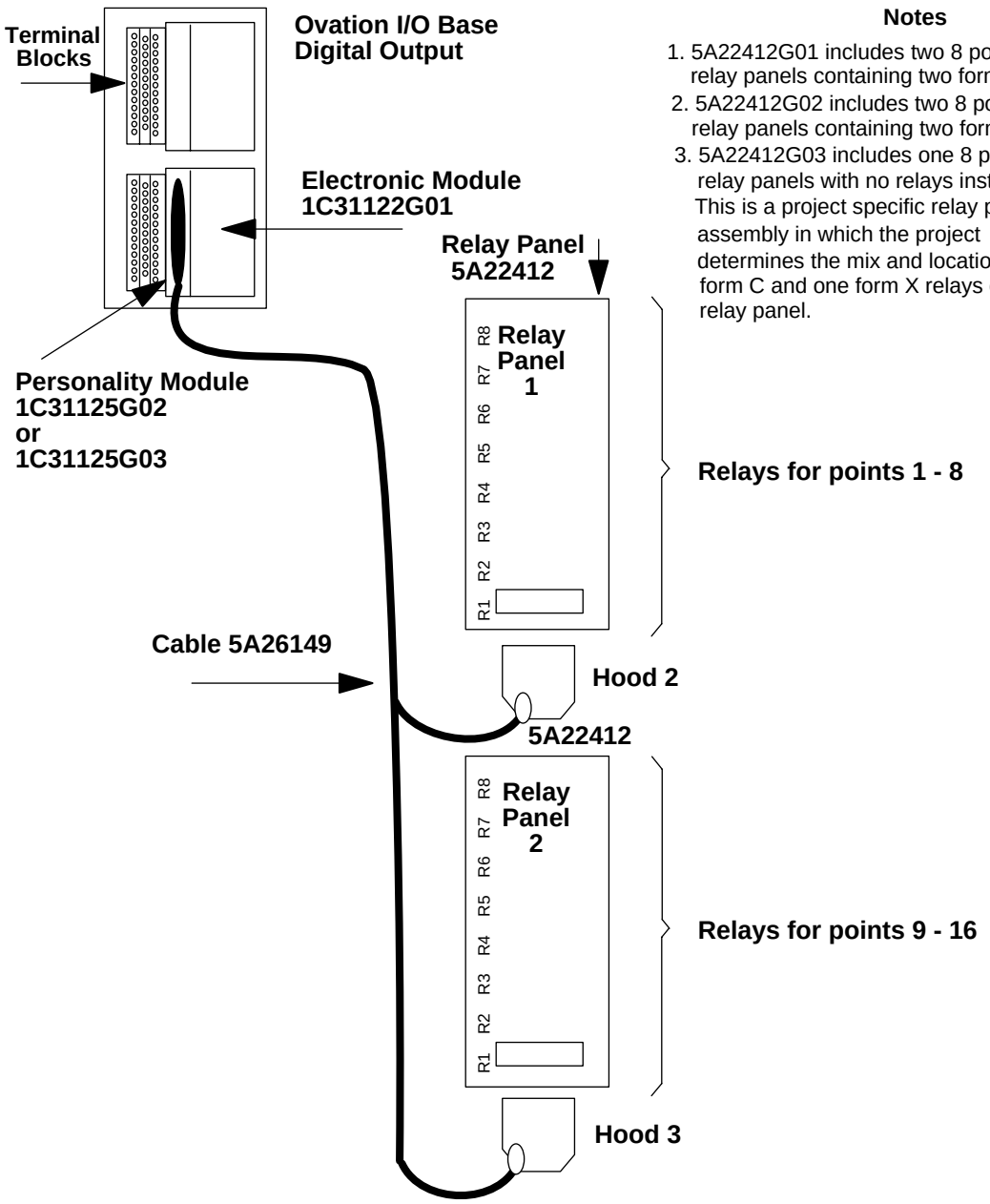

Terminal Blocks
Ovation I/O Base Digital Output
Electronic Module 1C31122G01
Relay Panel 5A22412
Personality Module 1C31125G02 or 1C31125G03
R8
R7
R6
R5
R4
R3
R2
R1
Relay Panel 1
Relays for points 1 - 8
Cable 5A26149
Hood 2
5A22412
Relay Panel 2
Relays for points 9 - 16
Hood 3
Notes
1. 5A22412G01 includes two 8 position relay panels containing two form C relays.
2. 5A22412G02 includes two 8 position relay panels containing two form X relays.
3. 5A22412G03 includes one 8 position relay panels with no relays installed. This is a project specific relay panel assembly in which the project determines the mix and location of two form C and one form X relays on the relay panel.

Figure 67: KUEP Relay Panels to Ovation I/O Base

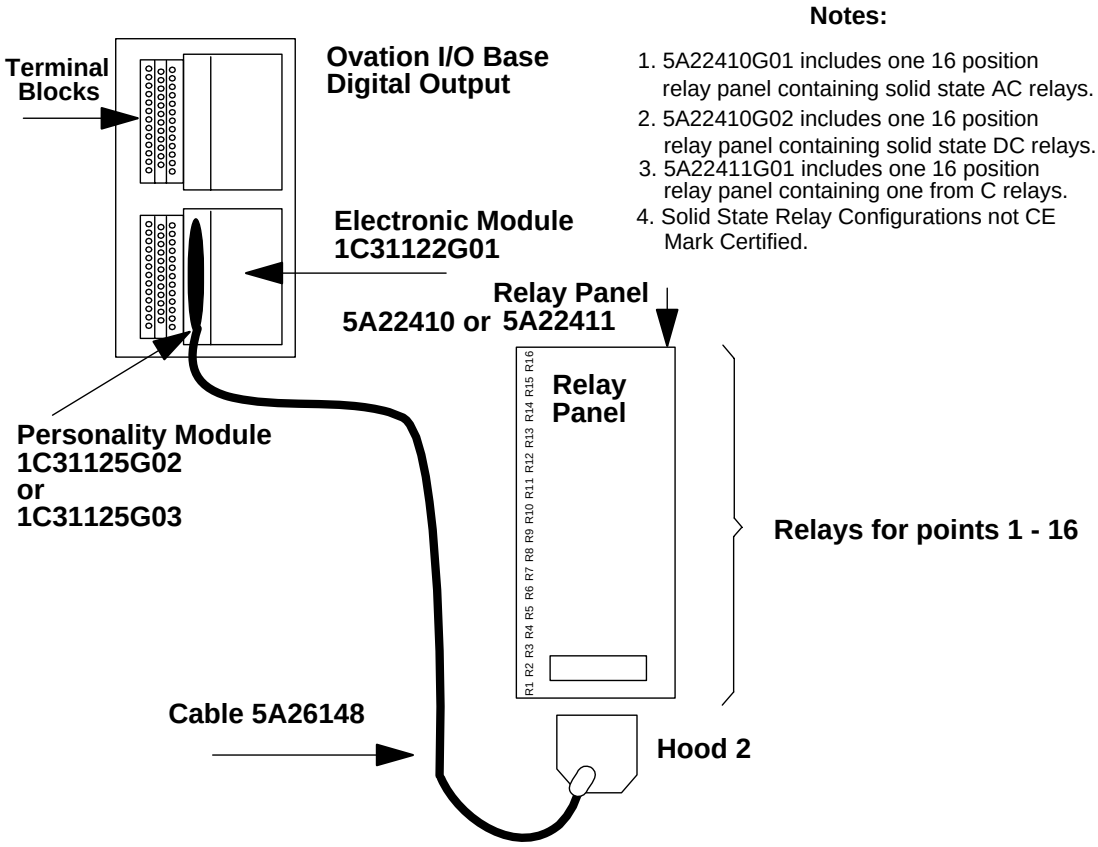

Notes:
1. 5A22410G01 includes one 16 position relay panel containing solid state AC relays.
2. 5A22410G02 includes one 16 position relay panel containing solid state DC relays.
3. 5A22411G01 includes one 16 position relay panel containing one from C relays.
4. Solid State Relay Configurations not CE Mark Certified.
Terminal Blocks
Ovation I/O Base Digital Output
Electronic Module 1C31122G01
Relay Panel 5A22410 or 5A22411
Relay Panel
R1 R2 R3 R4 R5 R6 R7 R8 R9 R10 R11 R12 R13 R14 R15 R16
Personality Module 1C31125G02 or 1C31125G03
Relays for points 1 - 16
Cable 5A26148
Hood 2

Figure 68: Solid State or G2R Relay Panels to Ovation I/O Base

12.5 Address Location Information

12.5.1 Digital Output Address Locations

Configuration and Status Register

Word address 13 (D in Hex) is used to configure the module and provide status information to the Controller. The status register can be read by using the Point Information window at an Operator Station (see the Bit Pattern field on the Hardware tab). (See the *Ovation Operator Station User Guide.)*

Digital Output Configuration/Status Register (Address 13 or D in Hex)

BIT	DATA DESCRIPTION - CONFIGURATION REGISTER (WRITE)	DATA DESCRIPTION - STATUS REGISTER (READ)
0	Configured (active high)	Configured (active high) (1=configured; 0=unconfigured)
1	Forced Error (active high)	Forced Error (active high) (1=forced error; 0=no forced error)
2- 4	Communications Timeout Setting [1] BIT 4 / BIT 3 / BIT 2 / TIMEOUT 0 0 0 16 seconds 0 0 1 4 seconds 0 1 0 2 seconds 0 1 1 1 seconds 1 0 0 500 milliseconds 1 0 1 250 milliseconds 1 1 0 125 milliseconds 1 1 1 62.5 milliseconds	Communications Timeout Setting [1] BIT 4 / BIT 3 / BIT 2 / TIMEOUT 0 0 0 16 seconds 0 0 1 4 seconds 0 1 0 2 seconds 0 1 1 1 seconds 1 0 0 500 milliseconds 1 0 1 250 milliseconds 1 1 0 125 milliseconds 1 1 1 62.5 milliseconds
5	Outputs hold their state on communications timeout (active high)	Outputs hold their state on communications timeout (active high)
6	Not used	Indicates the status of the blown fuse detection circuit (high = field supply fuse is blown)
7	Enable blown detection circuit (active high)	Enable blown detection circuit (active high)

[1] The tolerance on the timeout period is +/- 35%.

Bit definitions for this register are encoded as shown in the above table and described below:

Bit 0: When Bit 0 is set, the module is configured. The Controller configures the module by writing a “1” to bit 0 of the configuration register. Once configured, it remains configured until a power up/down reset is generated. After a power-up condition, the configuration register is cleared.

Bit 1: When Bit 1 is set, the internal error LED is turned on and data registers can be written but not read.

Bits 2-4: These bits are used to select the communication timeout period.

Bit 5: When Bit 5 is set, the digital outputs hold their last state on a communications watchdog timeout. When Bit 5 is cleared, the digital outputs are cleared (output transistor is shut off) on a communications watchdog timeout.

Bit 6: This bit indicates the status of the blown fuse detection circuit (see page 164). When Bit 6 of the status register is set, the field supply fuse is blown.

Bit 7: When Bit 7 is set, the blown fuse detection circuit is enabled.

12.6 DIAGNOSTIC LEDS

The following table lists the module's LEDs and describes what they mean when lit.

Digital Output Diagnostic LEDs

LED	DESCRIPTION
P (Green)	Power OK LED. Lit when the +5V power is OK.
C (Green)	Communications OK LED. Lit when the Controller is communicating with the module.
E (Red)	External Fault LED. Lit when the field supply fuse is blown and the blown fuse detection circuit is enabled. Blown Fuse bit (Bit 7) of the Configuration Register (see page 173) enables or disables the fuse detection circuit (high = enabled).
I (Red)	Internal Fault LED. Lit whenever the Force Error bit (Bit 1 of the Configuration Register (see page 173)) is active, or the Controller stops communicating with the module.
CH1 - CH 16 (Green)	If the LED is lit, this indicates that the output is in the ON state. If the LED is not lit, this indicates that the output is in the OFF state.

12.7 SPECIFICATIONS

Electronics Module (1C31122)

Personality Module (1C31125)

Digital Output Module Specifications

DESCRIPTION	VALUE
Number of channels	16
Output voltage	
Off voltage (maximum)	60 VDC
On voltage (maximum)	1.0 V @ 500mA
	0.2 V @ 100mA

DESCRIPTION	VALUE
Output current	
Off current (maximum)	25µA @ TA = 25°C, VDS = 60 VDC
	250µA @ TA = 60°C, VDS = 60 VDC
On current for all 16 outputs combined (max)	Limited by fuse rating
	890mA maximum for all 16 outputs
Personality module Group 1	2.2A maximum for all 16 outputs
Personality module Group 2 [1]	Limited by the fuse located on the relay module
Personality module Group 3 [1]	500 mA
On current for individual output (max)	
Blown fuse detection [2]	
Operating voltage range	15V ≤ field supply voltage ≤ 60V
Maximum propagation time	2.5 mSec for Rload=500Ω
Dielectric isolation: [3]	
Channel to logic	1000V AC/DC
Module power	Main: 2.2 W typical, 3.3 W maximum Aux used with no relay panels: 8 outputs on @ 100mA each 19.2 W (24V) typical 38.4 W (48V) typical Aux used with the following relay panels: Solid State panel with 16 relays: 5.9 W (24V) typical G2R panel with 16 relays: 10.87 W (24V) typical KUEP panel with 8 Form C relays: 15.84 W (24V) typical 2 KUEP panels with 16 Form C relays: 31.68 W (24V)typical KUEP panel with 8 Form X relays: 11.28 W (24V) typical 2 KUEP panels with 16 Form X relays: 22.56 W (24V)typical
Operating temperature range	0 to 60°C (32°F to 140°F)
Storage temperature range	-40°C to 85°C (-40°F to 185°F)
Humidity (non-condensing)	0 to 95%

[1] The personality module Groups 2 and 3 are used to interface with the relay modules (see page 153).

[2] The user can configure the card to disable the blown fuse detection function.

[3] All 16 channels have a common return which is isolated from the logic ground.

SECTION 13

HART ANALOG INPUT MODULE

IN THIS SECTION

Description *177*
Module Group Information *177*
Module Specific Information *179*
Wiring Information *182*
Address Location Information *188*
Diagnostic LEDs *191*
Specifications *192*

13.1 DESCRIPTION

HART (Highway Addressable Remote Transducer) is a digital communication protocol designed for industrial process measurement applications. Field measurement devices (transmitters) interface a process control system via an analog 4-to-20 mA current loop. HART uses a low-level frequency shift-keyed sine wave signal that is superimposed on the standard 4-to-20 mA process measurement current loop. Since the HART sine wave signal is small and its average value is zero, the current loop analog 4-to-20 mA signal is not significantly affected by the presence of the HART signal. Using HART allows a field device to provide more than one measurement, which is a feature not available when using only the 4-to-20 A analog current signal.

"Smart" field devices may be described as field devices in which the analog 4-to-20 mA signal, digital communication, and sometimes power, co-exist on the same pair of wires. The Ovation HART Analog Input (HAI) module is a standard form factor Ovation I/O module, which will permit Ovation to communicate with HART devices.

The HART Analog Input Module is applicable for CE Mark configured systems.

Note: *I/O Module General Information (see page 15) contains environmental, installation, wiring, and fuse information for I/O modules.*

13.2 MODULE GROUP INFORMATION

13.2.1 ELECTRONICS MODULE (EMOD)

There is one Electronics Module group for the HART Analog Input Module:

- **5X00058G01** interfaces to eight current loop signals with an input range of 4-20 mA.

13.2.2 PERSONALITY MODULE (PMOD)

There is one Personality Module group for the HART Analog Input Module.

- **5X00059G01** contains a single printed circuit board assembly with eight fused two-wire loop-powered or non-fused active-source (four-wire isolated current output) transmitter inputs. Eight user serviceable fuses (one fuse for each analog input channel) are located on the Pmod. Each fuse protects the auxiliary power supply only if the associated analog input channel is connected to a two-wire loop powered current transmitter.

Note: *Revision 02 and later personality modules contain a ninth user serviceable fuse (1/2 A) for the electronics module +24 VDC auxiliary power input.*

13.2.3 SUBSYSTEMS, HART ANALOG INPUT (16 BIT)

HART Analog Input Subsystems (16 Bit) [1]

RANGE	CHANNELS	EMOD	PMOD
4-20 mA loop powered (2 wire) or active source (4 wire)	8	5X00058G01	5X00059G01
[1] This configuration is CE Mark Certified.			

13.3 MODULE SPECIFIC INFORMATION

13.3.1 MODULE BLOCK DIAGRAM

The Ovation HART Analog Input Module assembly consists of two modules: an electronics module containing a logic printed circuit board (LHA) and a field printed circuit board (FHI). The simplified block diagram for the FHI field board is shown below. The electronics module is used in conjunction with a personality module, which contains a single printed circuit board (PHAI).

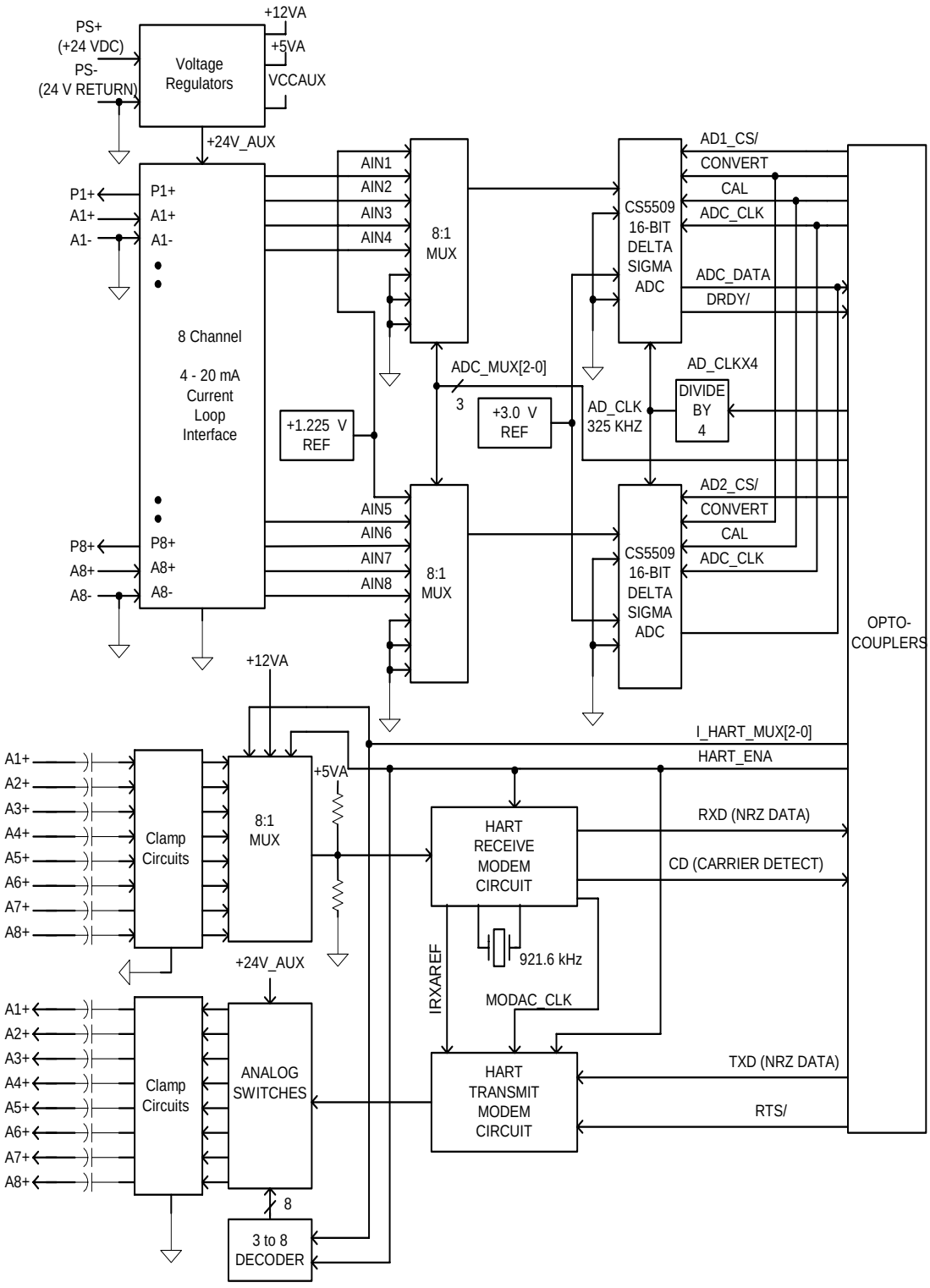


Figure 69: HART Analog Input Electronics Module FHI Field Board Block Diagram

13.3.2 EXTERNAL POWER SUPPLIES

Note: *Module power specifications (main and auxiliary) refer to the actual power drawn by the module from the 24 VDC main power supply and from the +24 VDC auxiliary power supply and* ***NOT*** *from the AC or DC mains.*

The HART Analog Input Module utilizes the standard +24V Ovation main power supply to provide the power required for the logic circuitry.

The HART Analog Input Module utilizes a +24 auxiliary power supply to provide the power required for the field circuitry. This includes all 4-20 mA loop power, A/D conversion, and the remaining output channel components.

It is recommended that the HART Analog Input module utilize the Ovation cabinet's Auxiliary +24V DC power that is obtained from the standard Ovation DIN Rail power supply auxiliary output.

However, if an external auxiliary power supply is utilized by the HART Analog Input module, the power supply output noise cannot exceed 2.2 mVRMS Maximum for all rated loads across the frequency range of 500 HZ to 10 kHZ, see the following figure.

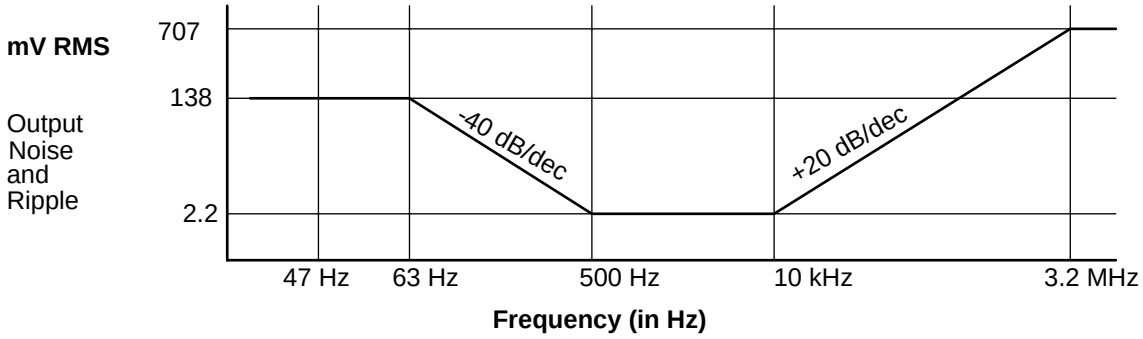


Figure 70: Power Supply Output Noise Requirements

If an external power supply is used, Using an External Power Supply (see page 539) contains steps to be undertaken before connecting the external power supply to the Ovation I/O base unit terminal block.

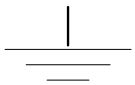
In addition, all modules utilizing the auxiliary power supplies, including the HART modules, **MUST** utilize shielded I/O cables in order to suppress coupled noise and transients into the HART modules. This includes modules on the same branch utilizing the auxiliary power, or modules on other branches utilizing the same auxiliary power. This recommendation applies regardless of the type of power supply chosen by the user.

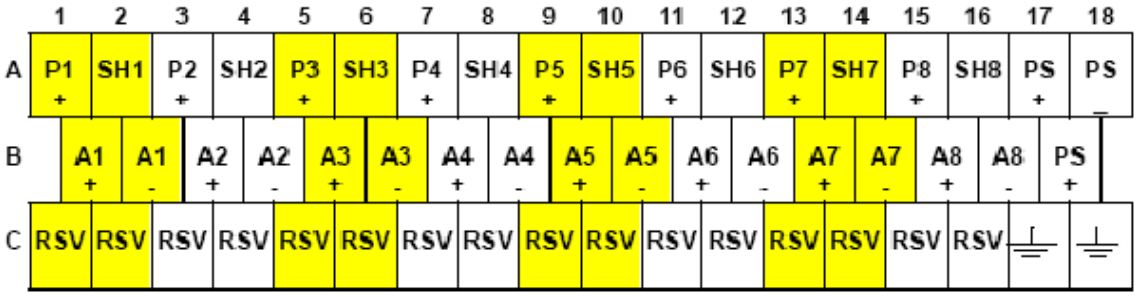
13.4 WIRING INFORMATION

13.4.1 HART ANALOG INPUT TERMINAL BLOCK WIRING INFORMATION

Each Personality module has a simplified wiring diagram label on its side which appears above the terminal block. This diagram indicates how the wiring from the field is to be connected to the terminal block in the base unit.

Abbreviations Used in Diagrams

ABBREVIATION	DEFINITION
A1 - A8 +	Analog Input terminal connection (connected to the negative terminal of a loop powered two-wire current transmitter or the positive terminal of an active-source current transmitter).
A1 - A8 -	Analog Input negative terminal connection (active-source only).
P1 - P8 +	Loop power output terminals (for loop powered two-wire current transmitters - connect to their positive terminal).
SH1 - SH8	Shield terminal connection.
	Earth ground terminals.
PS+, PS-	External Auxiliary power supply terminals.
RSV	Reserved terminal. No connections are allowed on these terminals.


1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18
A P1 + SH1 P2 + SH2 P3 + SH3 P4 + SH4 P5 + SH5 P6 + SH6 P7 + SH7 P8 + SH8 PS + PS -
B A1 + A1 - A2 + A2 - A3 + A3 - A4 + A4 - A5 + A5 - A6 + A6 - A7 + A7 - A8 + A8 - PS +
C RSV RSV RSV RSV RSV RSV RSV RSV RSV RSV RSV RSV RSV RSV RSV RSV

13.4.2 HART Analog Input Field Connection Wiring Diagrams (Non-CE Mark Certified Systems)

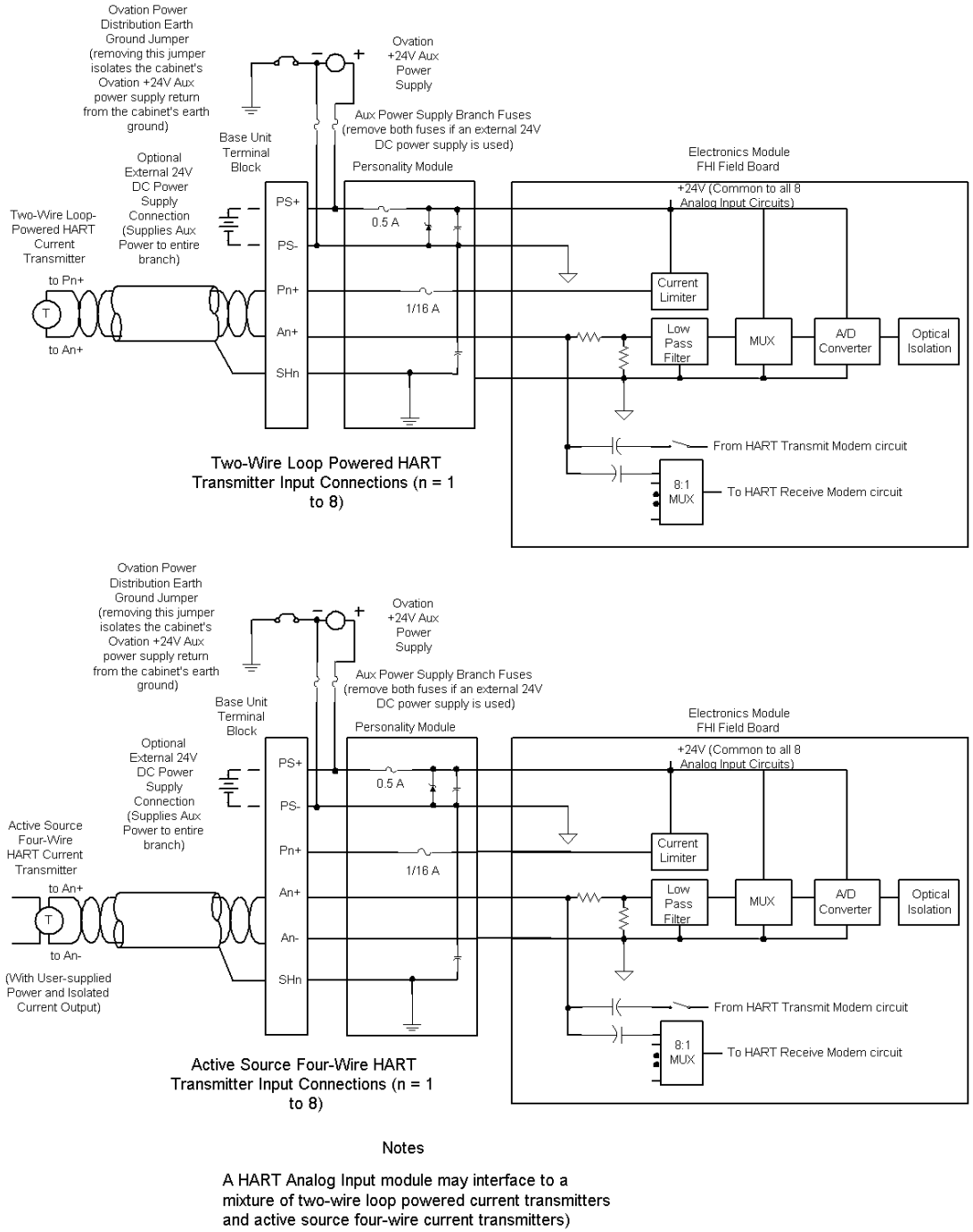
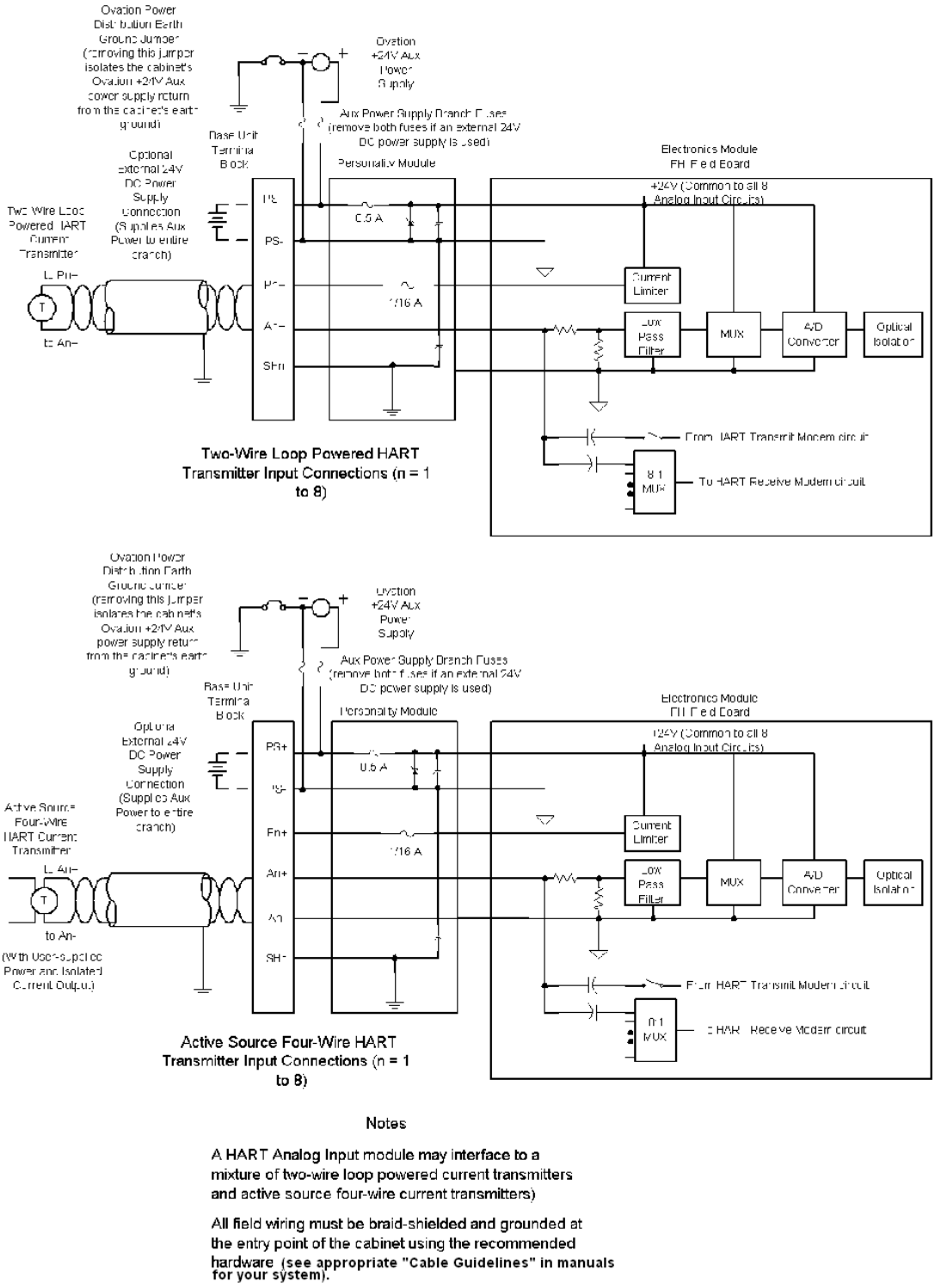

Ovation Power Distribution Earth Ground Jumper (removing this jumper isolates the cabinet's Ovation +24V Aux power supply return from the cabinet's earth ground)
Ovation +24V Aux Power Supply
Aux Power Supply Branch Fuses (remove both fuses if an external 24V DC power supply is used)
Base Unit Terminal Block
Optional External 24V DC Power Supply Connection (Supplies Aux Power to entire branch)
Personality Module
Electronics Module FHI Field Board
+24V (Common to all 8 Analog Input Circuits)
Two-Wire Loop-Powered HART Current Transmitter
to Pn+
to An+
PS+
PS-
Pn+
An+
SHn
0.5 A
1/16 A
Current Limiter
Low Pass Filter
MUX
A/D Converter
Optical Isolation
From HART Transmit Modem circuit
8:1 MUX
To HART Receive Modem circuit
Two-Wire Loop Powered HART Transmitter Input Connections (n = 1 to 8)
Ovation Power Distribution Earth Ground Jumper (removing this jumper isolates the cabinet's Ovation +24V Aux power supply return from the cabinet's earth ground)
Ovation +24V Aux Power Supply
Aux Power Supply Branch Fuses (remove both fuses if an external 24V DC power supply is used)
Base Unit Terminal Block
Optional External 24V DC Power Supply Connection (Supplies Aux Power to entire branch)
Personality Module
Electronics Module FHI Field Board
+24V (Common to all 8 Analog Input Circuits)
Active Source Four-Wire HART Current Transmitter
to An+
to An-
(With User-supplied Power and Isolated Current Output)
PS+
PS-
Pn+
An+
An-
SHn
0.5 A
1/16 A
Current Limiter
Low Pass Filter
MUX
A/D Converter
Optical Isolation
From HART Transmit Modem circuit
8:1 MUX
To HART Receive Modem circuit
Active Source Four-Wire HART Transmitter Input Connections (n = 1 to 8)
Notes
A HART Analog Input module may interface to a mixture of two-wire loop powered current transmitters and active source four-wire current transmitters)

Figure 71: HART Analog Input Connections (Non CE Mark)

13.4.3 HART ANALOG INPUT FIELD CONNECTION WIRING DIAGRAMS (CE MARK CERTIFIED SYSTEMS)


Ovation Power Distribution Earth Ground Jumper (removing this jumper isolates the cabinet's Ovation +24V Aux power supply return from the cabinet's earth ground)
Ovation +24V AUX Power Supply
Aux Power Supply Branch Fuses (remove both fuses if an external 24V DC power supply is used)
Base Unit Terminal Block
Optional external 24V DC Power Supply Connection (Supplies Aux Power to entire branch)
Personality Module
Electronics Module FTA Field Board
+24V (Common to all 8 Analog Input Circuits)
Two Wire Loop Powered HART Current Transmitter
0.6 A
1/16 A
Current Limiter
Low Pass Filter
MUX
A/D Converter
Optical Isolator
From HART Transmit Modem circuit
8:1 MUX
To HART Receive Modem circuit
Two-Wire Loop Powered HART Transmitter Input Connections (n = 1 to 8)
Active Source Four-Wire HART Current Transmitter
(With User-Supplied Power and Isolated Current Output)
Active Source Four-Wire HART Transmitter Input Connections (n = 1 to 8)

Notes

A HART Analog Input module may interface to a mixture of two-wire loop powered current transmitters and active source four-wire current transmitters)

All field wiring must be braid-shielded and grounded at the entry point of the cabinet using the recommended hardware (see appropriate "Cable Guidelines" in manuals for your system).

Figure 72: HART Analog Input Field Connections (CE Mark)

13.4.4 Field Wiring Cable Requirements

Field I/O cable must be one or more single-twisted pair shielded or multiple-twisted pair with overall shield. Single and multiple pair may be combined provided that all of the shields share a common connection to earth ground in the Ovation cabinet.

Recommended Minimum Conductor Size

Cable Length	Min. Conductor Size	Cable Type
Below 5,000 feet (1524 m)	24 AWG (0.51 mm dia.)	Single-twisted pair shielded or multiple-twisted pair with over-all shield.
Above 5,000 (1524 m)	20 AWG (0.81 mm dia.)	Single-twisted pair shielded.

The maximum length of cable per HART network is dependent on the characteristics of the devices connected to the network and the characteristics of the cable to be used.

In a HART network, long cable lengths are possible when the dominant low impedance device (the HART Analog Input module) has an input impedance of approximately 250 ohms. Low capacitance good-quality cable is used, and the Smart transmitter (high impedance device) has a low input capacitance (less than 5000 pF) and a high input resistance (greater than 100 K ohm).

Example: Cable Length Calculation

Single Smart Transmitter, parallel network resistance = 250 ohm (HART Analog Input module input impedance)
Smart Transmitter Capacitance: 5000 pF
Cable Capacitance (Cx): 50 pF/ft.
Cable Resistance (Rx): 0.016 ohm/ft. (22 AWG)

Cx = Cable capacitance per unit length (feet or meters): The capacitance from one conductor to all other conductors (including the shield if shielded). This value is usually available from the cable manufacturer.

Rx = Cable resistance per unit length (feet or meters): This value should be available from the cable manufacturer. The table below contains the resistance values of some common copper wire sizes. The resistance per unit length is for a single wire but the length calculations and charts take into account the resistance of both wires.

Copper Wire Resistance Table

Wire Size (AWG)	Resistance per ft. (Ohms)	Resistance per meter (Ohms)	Wire Size (sqmm)	Resistance per meter (Ohms)
16	0.0040	0.013	0.5	0.0368
17	0.0050	0.016	0.75	0.0265
18	0.0064	0.021	1.0	0.0184
19	0.0080	0.026	1.5	0.0123
20	0.010	0.032	_	_
21	0.013	0.042	_	_
22	0.016	0.052	_	_

WIRE SIZE (AWG)	RESISTANCE PER FT. (OHMS)	RESISTANCE PER METER (OHMS)	WIRE SIZE (SQMM)	RESISTANCE PER METER (OHMS)
23	0.020	0.066	_	_
24	0.026	0.085	_	_
25	0.032	0.10	_	_
26	0.041	0.13	_	_
27	0.051	0.17	_	_
28	0.065	0.21	_	_
29	0.082	0.27	_	_
30	0.100	0.33	_	_

From the following figure, using cable capacitance (Cx) of 50 pF/unit length and resistance (Rx) of 0.016 ohm/unit length, a direct reading of the corresponding length on the y-axis is approximately 3600 feet (unit length of feet from above parameters).

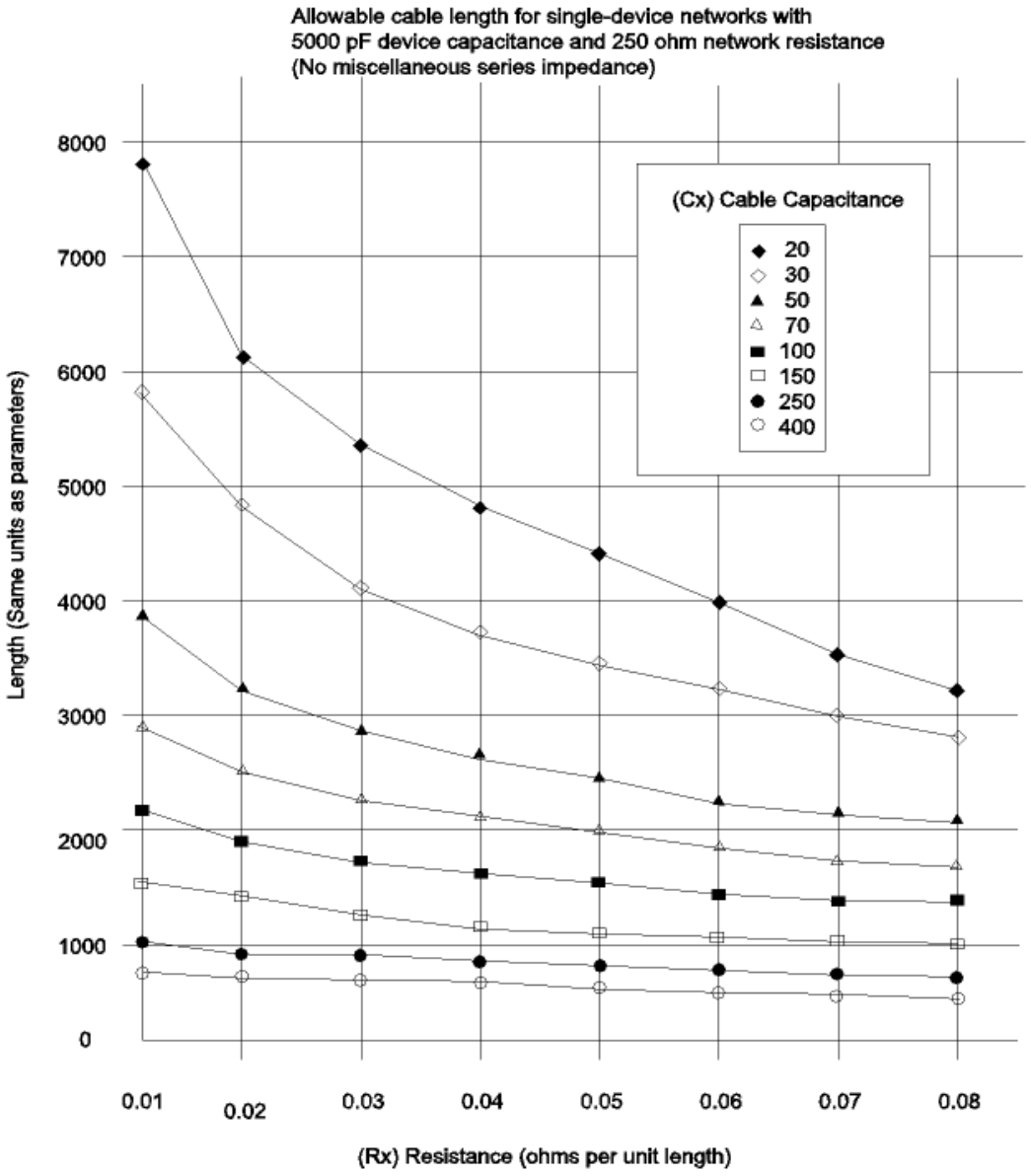


Figure 73: Length Graph - Single Device Network

13.5 Address Location Information

13.5.1 Configuration and Status Register

Each of the 16 direct registers on the HART Analog Input module is summarized here and shown in more detail in the following tables. The status register can be read by using the Point Information window at an Operator's Station.

HART Analog Input Register Map

Reg	Data Description - Configuration Register (Write)	Data Description - Status Register (Read)
0	Indirect Memory Index	NA
1	Indirect Memory Data	Indirect Memory Data
2	NA	Analog Input - Channel 1
3	NA	Analog Input - Channel 2
4	NA	Analog Input - Channel 3
5	NA	Analog Input - Channel 4
6	NA	Analog Input - Channel 5
7	NA	Analog Input - Channel 6
8	NA	Analog Input - Channel 7
9	NA	Analog Input - Channel 8
10	NA	Firmware Status Flags
11	NA	HAI Firmware Revision
12	NA	Channel Error Bits
13	Module Configuration Register	Module Status Register (See table below)
14	HART Enable	NA
15	NA	Module Electronic ID Data

HART AI Configuration/Status Register (Address 13 or D in Hex)

Bit	Data Description (Write)	Data Description (Read)
0	Configure Module	Module Configured (1 = configured; 0 = unconfigured)
1	Force Error	Internal or forced error (1 = forced error; 0 = no forced error)
2	Reserved	NA

BIT	DATA DESCRIPTION (WRITE)	DATA DESCRIPTION (READ)
3	Reserved	NA
4	Reserved	NA
5	Reserved	NA
6	Reserved for Factory Test (must always be set to 0)	NA
7	Reserved for Factory Test (must always be set to 0)	NA
8	NA	Hardware Error
9	NA	Bank 1 reference error
10	NA	Bank 2 reference error
11	Not Used	Not Used
12	Not Used	Not Used
13	Not Used	Not Used
14	NA	Field power failed
15	Reserved	Reserved

Bit definitions for this register are encoded as shown in the above table are described below:

Bit 0: This bit configures the module (write) or indicates the configuration state of module (read). A “1” indicates that the module is configured.

Bit 1: Forces the module into error state, illuminating the module’s Error LED.

Bits 2 - 5, 11 - 13: Not used by the module.

Bits 6 - 7: Reserved for factory test, must always be set to 0.

Bit 8: Hardware error. Indicates one or more of the following is true:

- The FPGA did not program correctly on startup.
- The EE memory checksum is incorrect.
- The PROM checksum test has failed.
- Internal memory diagnostic has failed.

Bit 9: Reference error on first mux/AD combination.

Bit 10: Reference error on second mux/AD combination.

Bit 14: Field power failed.

Bit 15: Reserved.

13.5.2 HART Analog Input Enable Register (Address 14 or E in Hex)

HART Analog Input Enable Register (Address 14 or E in Hex)

Bit	Data Description - Configuration Register (Write)	Data Description - Status Register (Read)
0	Multivariable Channel 1	Not Used
1	Multivariable Channel 2	Not Used
2	Multivariable Channel 3	Not Used
3	Multivariable Channel 4	Not Used
4	Multivariable Channel 5	Not Used
5	Multivariable Channel 6	Not Used
6	Multivariable Channel 7	Not Used
7	Multivariable Channel 8	Not Used
8	HART Enabled - Channel 1	Not Used
9	HART Enabled - Channel 2	Not Used
10	HART Enabled - Channel 3	Not Used
11	HART Enabled - Channel 4	Not Used
12	HART Enabled - Channel 5	Not Used
13	HART Enabled - Channel 6	Not Used
14	HART Enabled - Channel 7	Not Used
15	HART Enabled - Channel 8	Not Used

Bit definitions for this register are encoded as shown in the above table and described below:

Bits 0-7: These bits are set to enable multivariable messaging. Refer to the IO configuration guide for additional information.

The HAI, HAO, and IAH modules have the ability to retrieve additional variables from a field device. These variables are referred to as 'multivariables' and are named PV (primary variable), SV (secondary variable), TV (tertiary variable), and QV (quarterly variable).

If the bit is set, the module will periodically retrieve whatever variables exist for the device.

The definitions of PV, SV, TV, and QV are found in the user's manual for the field device supplied by the device manufacturer. The standard format of these four variables is IEEE 794, a floating-point format.

You must configure IO point records to cause the Controller to scan the module and retrieve the variables. (See the *Point Builder User Guide* or *Developer Studio User Guide*.)

Bits 8-15: In the IO configuration tool, you can set these flags on a per-channel basis to allow HART messaging, including multivariable messaging, to flow on that channel.

You should ensure that these bits are cleared for non-HART field devices. To avoid a HART communication error message, set each bit at "0" when connecting a non-HART output device.

13.6 DIAGNOSTIC LEDS

The following table lists the module's LEDs and describes what they mean when lit.

HART Analog Input Diagnostic LEDs

LED	DESCRIPTION
P (Green)	Power OK LED. Illuminated when the +5V power is OK.
C (Green)	Communications OK LED. Illuminated when the Controller is communicating with the module.
E (Red)	External Error LED. Illuminated upon loss of external auxiliary (field) power, as indicated by the loss of normal transitions of the EOC (end-of-convert) signal.
I (Red)	Internal Error LED. Illuminated whenever there is any type of error within the module except for a loss of external auxiliary power. Possible causes are: ▪ The Controller sets the module's Force Error bit. ▪ Communications with the Controller is lost. ▪ The ground or reference reading is out of range. ▪ Flash memory, EE memory or RAM diagnostic failure.

LED	DESCRIPTION
1-8 (Green)	After module configuration, the bank of eight channel LEDs (LEDs 1 through 8) is used to indicate HART communication activity. When a HART message is sent, the LED for that particular channel is illuminated. When the HART response is received correctly, the LED is extinguished. Therefore, when all is normal, that is, messages and responses are properly exchanged, a single LED blink will be observed on the module's front cap. If a HART message is sent and no response is received, the HART Analog Input module exclusive-OR's the channel LED display with hex code 0xFF. This results in all channel LEDs being illuminated except for the selected channel. For example, if the HART Analog Input module sent a HART message to device on channel 2, but the device was not connected to channel 2, the module would first illuminate LED 2 (all seven other channel LEDs extinguished). The module would then extinguish LED 2 and flash the other seven channel LEDs. This status indicates that the module sent a HART message on channel 2 and did not receive a valid response message after the initial message attempt or after any of the subsequent message retries.

13.7 SPECIFICATIONS

Electronics Module (5X00058)

Personality Module (5X00059)

HART Analog Input Module Specifications

DESCRIPTION	VALUE
Number of channels	8
Input range	4 to 20 mA normal operation 0 to 23 mA with under-range and over-range levels user selected and Controller monitored.
A/D Resolution	16 bits
Reference accuracy (@ 25oC)	+/-0.05% of span @ 99.7% confidence
Accuracy over temperature	+/-0.1% of span over the full operating temperature range
Sampling rate (per ms)	Each channel is sampled every 24 ms.
Dielectric isolation: Channel to channel Channel to logic	No channel to channel isolation 1000 VAC/VDC for one minute
Operating temperature range	0o to 60oC. (32oF to 140oF)
Humidity (non-condensing)	0% to 95%
Module power	Main: 1.2W typical. 2.5W maximum Aux. power supply voltage = 24 VDC -5%, +6.25% Aux: 4.1W typical. 7.2W maximum
Two-wire transmitter power	13.5V minimum (Pn+ to An+) @ 20 mA where n = 1 to 8 (current limited to 32 mA maximum)

SECTION 14

HART HIGH PERFORMANCE ANALOG INPUT MODULE

IN THIS SECTION

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Module Group Information *194*
Module Specific Information *195*
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Specifications *204*

14.1 DESCRIPTION

The HART (Highway Addressable Remote Transducer) High Performance (HP) Analog Input module is a standard Ovation I/O Module that provides eight galvanically isolated 4-20 mA analog inputs with HART transceivers. Each transceivers provides optically isolated communication to a dedicated UART (Universal Addressable Remote Transducer), thereby maximizing HART communication throughout. Each channel may be individually configured for field powered or local powered transmitters via user accessible jumpers on the Personality Module.

HART is a digital communication protocol designed for industrial process measurement applications. Field measurement devices (transmitters) interface for a process control system via an analog 4-to-20 mA current loop. HART uses a low-level frequency-shift-keyed sine wave signal that is superimposed on the standard 4-to-20 mA process measurement current loop. Since the HART sine wave signal is small and its average value is zero, the current loop analog 4-to-20 mA signal is not significantly affected by the presence of the HART signal. Using HART allows a field device to provide more than one measurement, which is a feature not available when using only the 4-to-20mA analog current signal.

“Smart” field devices may be described as field devices in which the analog 4-to-20 mA signal, digital communication, and sometimes power, co-exist on the same pair of wires. The Ovation HART High Performance Analog Input (IAH) module is a standard form factor Ovation I/O module, which will permit Ovation to communicate with HART devices.

Note: *I/O Module General Information (see page 15) contains environmental, installation, wiring, and fuse information for I/O modules.*

14.2 MODULE GROUP INFORMATION

14.2.1 PERSONALITY MODULE (PMOD)

There is one Personality Module group for the HART HP Analog Input Module.

- **5X00109G01** contains a single printed circuit board assembly with eight fused input and user accessible jumpers that configure the channels for field powered or local powered transmitters on an individual basis.

14.2.2 ELECTRONICS MODULE (EMOD)

There is one Electronics Module group for the HART HP Analog Input Module:

- **5X00106G01** interfaces to eight current loop signals with an input range of 4-20 mA.

14.2.3 SUBSYSTEMS, HART HP ANALOG INPUT (16 BIT)

HART HP Analog Input Subsystems (16 Bit)

RANGE	CHANNELS	ELECTRONIC MODULE	PERSONALITY MODULE
4-20 mA	8	5X00106G01	5X00109G01

14.3 MODULE SPECIFIC INFORMATION

14.3.1 MODULE BLOCK DIAGRAM AND FIELD CONNECTION WIRING DIAGRAM

The Ovation HART HP Analog Input Module subsystem consists of two modules, an electronics module containing a logic printed circuit board (LIH) and a field printed circuit board (FIH). The electronics module is used in conjunction with a personality module, which contains a single printed circuit board (PIHA).

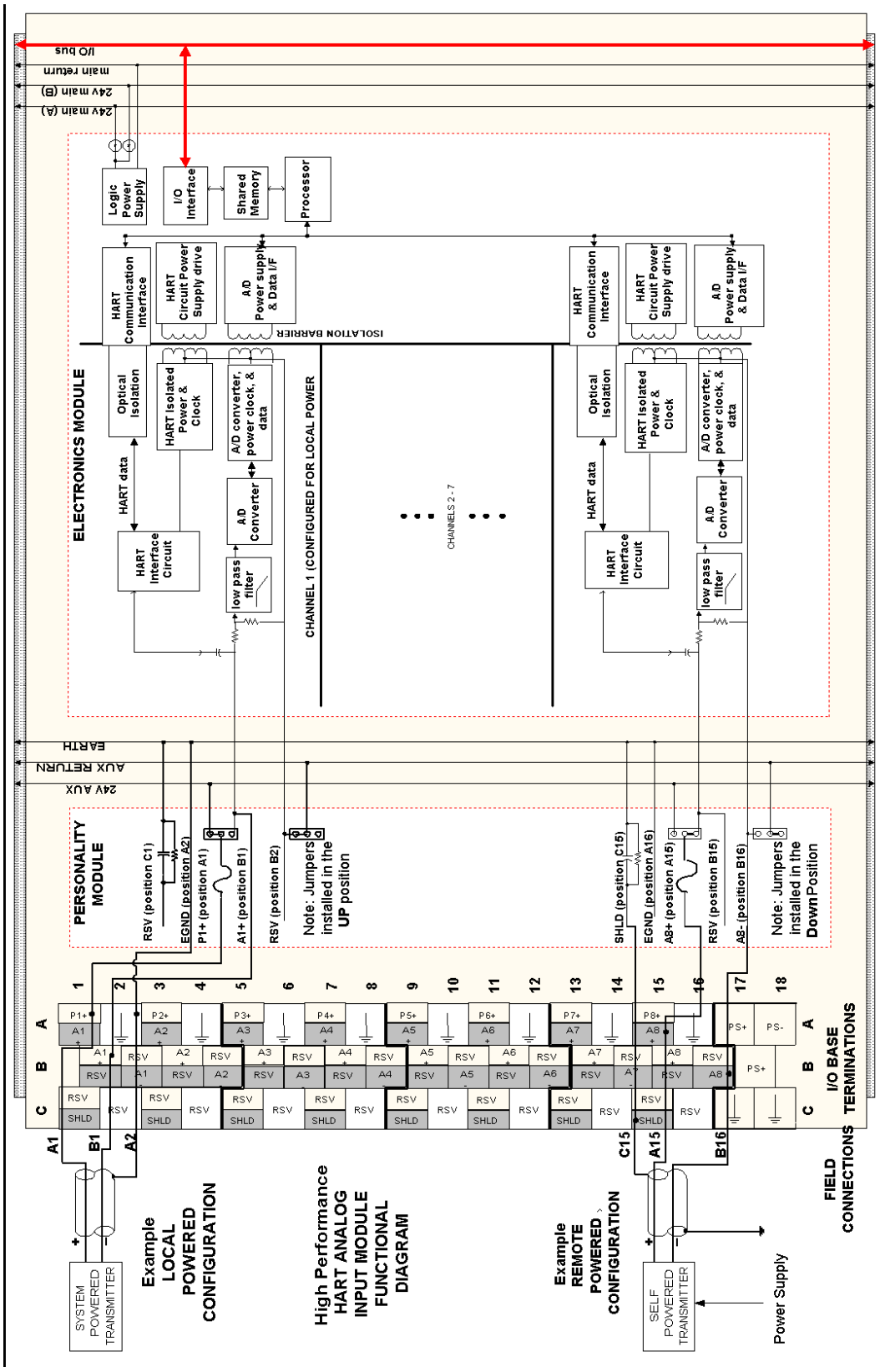


Figure 74: HART HP Analog Input Subsystem Block Diagram

14.3.2 EXTERNAL POWER SUPPLIES

Note: *Module power specifications (main and auxiliary) refer to the actual power drawn by the module from the 24 VDC main power supply and from the +24 VDC auxiliary power supply and* ***NOT*** *from the AC or DC mains.*

The HART HP Analog Input Module utilizes the standard +24V Ovation main power supply to provide the power required for the logic circuitry.

The HART HP Analog Input Module utilizes a +24 auxiliary power supply to provide the power required for the field circuitry. This includes all 4-20 mA loop power, A/D conversion, and the remaining output channel components. This power supply may be the standard +24V Ovation Auxiliary Supply or a user supplied external power supply.

It is recommended that the HART Analog Input module utilize the Ovation cabinet's Auxiliary +24V DC power that is obtained from the standard Ovation DIN Rail power supply auxiliary output.

However, if an external auxiliary power supply is utilized by the HART Analog Input module, the power supply output noise cannot exceed 2.2 mVRMS Maximum for all rated loads across the frequency range of 500 HZ to 10 kHZ .

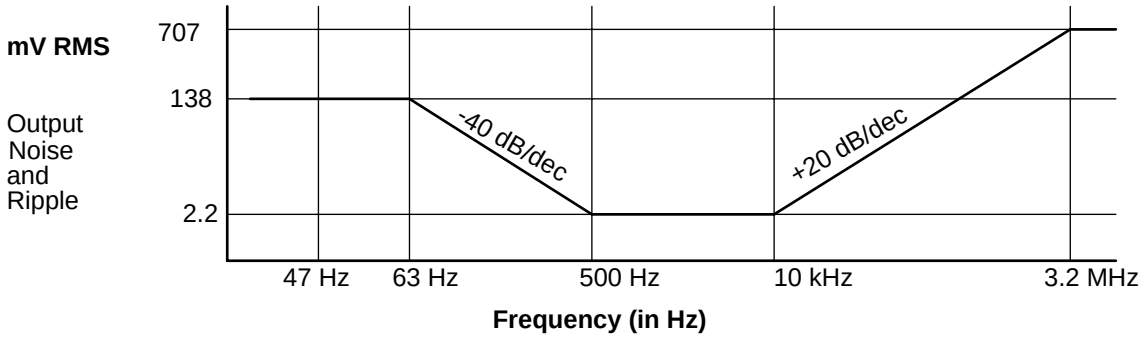


Figure 75: Power Supply Output Noise Requirements

In addition, all modules utilizing the auxiliary power supplies, including the HART modules, **MUST** utilize shielded I/O cables in order to suppress coupled noise and transients into the HART modules. This includes modules on the same branch utilizing the auxiliary power, or modules on other branches utilizing the same auxiliary power. This recommendation applies regardless of the type of power supply chosen by the user.

14.4 WIRING INFORMATION

14.4.1 HART HP ANALOG INPUT PERSONALITY MODULE INFORMATION

Each Personality module provides a 1/20 A fuse on each channel for loop protection. Additionally, each channel provides a pair of user accessible jumpers for configuring each channel for local powered transmitters or field powered transmitters. This configuration is on a per channel basis. The fuses and jumpers are accessible through the top of the module. The label, shown in the following figure, on the top of the module indicates how to position the jumpers. Note that there are two jumpers per channel and they must be positioned together.

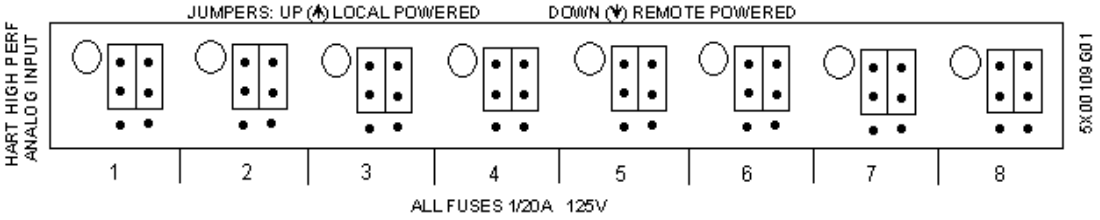


Figure 76: HART HP Analog Input Personality Module

Note: *Jumpers are shown in the local powered configuration for all channels.*

14.4.2 HART HP ANALOG INPUT TERMINAL BLOCK WIRING INFORMATION

Each Personality module has a simplified wiring diagram label on its side which appears above the terminal block. This diagram indicates how the wiring from the field is to be connected to the terminal block in the base unit. Note that there are two wiring configurations for each channel dependant upon whether the channel is configured for Local or Field powered transmitters.

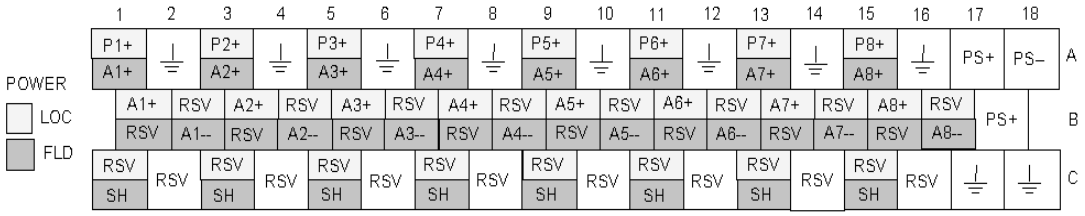
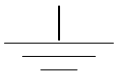


Figure 77: Wiring Diagram Label

The diagrams for the HART HP Analog Input Personality modules are illustrated in the figure above. The following table lists and defines the abbreviations used in those diagrams.

Wiring Diagram Label Definitions

ABBREVIATION	ABBREVIATION
A1 - A8 +	Analog Input terminal connection (connected to the negative terminal of a local powered transmitter or the positive terminal of field powered transmitter).

ABBREVIATION	ABBREVIATION
A1 - A8 -	Analog Input negative terminal connection (field powered configuration only).
P1 - P8 +	Loop power output terminals (for local powered configuration only. Connected to the positive).
SH1 - SH8	Shield terminal connection. (For landing shields where the shield is to be grounded at the transmitter).
	Earth ground terminals. (For landing shields where the shield is to be grounded at the module).
PS+, PS-	External Auxiliary power supply terminals.
RSV	Reserved terminal. No connections are allowed on these terminals.

14.4.3 FIELD WIRING CABLE REQUIREMENTS

Recommended Minimum Conductor Size

CABLE LENGTH	MIN. CONDUCTOR SIZE	CABLE TYPE
Less than 5,000 feet (1524 m)	24 AWG (0.51 mm dia.)	Single-twisted pair with over-all shield.
Greater than 5,000 feet, but less than 10,000 feet (3048 meters)	20 AWG (0.81 mm dia.)	Single-twisted pair with over-all shield.

Refer to the HART FSK Physical Layer Specification (HFC_SPEC-54) for additional cabling information.

The point data registers occupy locations 2-9 for analog input points 1-8 respectively. The data format is as follows:

Bit 15	Bit 14	Bit 13 - 0
		14 bit value
	Over-range Bit	
Point quality: (for good point quality (and proper card operation))		
Example Values		
Output Data in Hex		**Data Description**
8000		Zero Input
8001		+ 1
C000		+ Full Scale
CZZZ		+ Over Range
*0000-7FFF		*Card Trouble/Not Warmed Up/Bad Quality

14.5 Address Location Information

14.5.1 HART HP Analog Input Address Locations

Each of the 16 direct registers on the HART HP Analog Input module is summarized in the following tables and shown in more detail in the following tables. The module status register 13 (D in Hex) can be read by using the Point Information window at an Operator's Station. (See the *Ovation Operator Station User Guide.)*

HART Analog Input Register Map

Reg	Data Description - Configuration - Register (Write)	Data Description - Status Register (Read)
0	Indirect Memory Index	NA
1	Indirect Memory Data	Indirect Memory Data
2	NA	Analog Input - Channel 1
3	NA	Analog Input - Channel 2
4	NA	Analog Input - Channel 3
5	NA	Analog Input - Channel 4
6	NA	Analog Input - Channel 5
7	NA	Analog Input - Channel 6
8	NA	Analog Input - Channel 7
9	NA	Analog Input - Channel 8
10	Calibration Register (Factory use only)	Calibration Register (Factory use only)
11	Flash down Handshaking	Firmware Revision/ Flash download Handshaking
12	NA	Channel Error Bits
13	Module Configuration Register)	Module Status Register
14	HART Enable	HART Enable
15	NA	Module Electronic ID Data

Word address 12 (C in Hex) is used to report the channel errors on the eight input channels. The following table is for reference only, Individual bits are not user accessible.

Channel Error Register Output Data Format (Read)

POINT	BIT	DESCRIPTION
1	0	Communication to the Isolated Channel has failed
	1	Over/under-range, Input/blown fuse/Open Loop
2	2	Communication to the Isolated Channel has failed
	3	Over/under-range, Input/blown fuse/Open Loop
3	4	Communication to the Isolated Channel has failed
	5	Over/under-range, Input/blown fuse/Open Loop
4	6	Communication to the Isolated Channel has failed
	7	Over/under-range, Input/blown fuse/Open Loop
5	8	Communication to the Isolated Channel has failed
	9	Over/under-range, Input/blown fuse/Open Loop
6	10	Communication to the Isolated Channel has failed
	11	Over/under-range, Input/blown fuse/Open Loop
7	12	Communication to the Isolated Channel has failed
	13	Over/under-range, Input/blown fuse/Open Loop
8	14	Communication to the Isolated Channel has failed
	15	Over/under-range, Input/blown fuse/Open Loop

Communication to the Isolated Channel has failed - this bit is set when the communication to the corresponding isolated channel has failed.

Over/under-range, Input/blown fuse/Open Loop - this bit is set when the corresponding Points input is less than 2.5mA (open loop condition), or greater than 25mA (over-range).

Module Configuration/Status Register

The Module Configuration/Status register is module I/O register 13 (0xD). The register bit assignments are defined as follows:

Module Configuration/Status Register

BIT	DATA DESCRIPTION (WRITE)	DATA DESCRIPTION (READ)
0	Configure Module	Module Configured (1 = configured)
1	Force Error	Internal or forced error (1 = forced error)
2	50/60 hz selection (1=50 hz)	50/60 Hz System (1=50 Hz)
3	SELF_CAL (Initiates Self Calibration)	SELF_CAL (Initiates Self Calibration)

BIT	DATA DESCRIPTION (WRITE)	DATA DESCRIPTION (READ)
4	Toggle Bit (80C32 to 90S8515)	0, (Not Used)
5	0, (Not Used)	0, (Not Used)
6	0, (Not Used)	0, (Not Used)
7	80C32 diagnostics	80C32 diagnostics
8	0, (Not Used)	80C32 Memory Error
9	0, (Not Used)	9058515 Internal Error
10	0, (Not Used)	9058515 Memory Error
11	0, (Not Used)	Module not calibrated
12	0, (Not Used)	0, (Not Used)
13	Toggle Bit (90S8515 to 80C32)	Toggle Bit (90S8515 to 80C32)
14	0, (Not Used)	0, (Not Used)
15	0, (Not Used)	Point Fault[1]
[1]Refer to the Channel Error Register for the descriptions of the Point Faults.		

Bit 0: The Ovation Controller must set bit 0 of the Module Configuration register in order to access module I/O registers 0 through 11 (0xB). If bit 0 is not set, reading module I/O registers 0 through 11 (0xB) yields an Attention Status.

Bit 1: This bit (write “1”) forces the module into error state, illuminating the module’s internal Error LED. The read of bit “1” indicates that there is an internal module error, or the Controller has forced the module into the error state. The state of this bit is always reflected by the modules Internal Error LED. Whenever this bit is set, an attention status is returned to the Controller when addresses 0 through 11 (B in Hex) are read.

Bits 2: The status of this bit (read) indicates the conversion rate of the module, write to this bit configures the conversion rate of the A/D converters as shown in the following table.

CONVERSION RATE (1/SEC)	BIT #2
60 (for 60Hz systems)	0
50 (for 50Hz systems)	1

Bit 3: This bit (write) is used to initiate self-calibration. The sample rate during self-calibration will be two per second. The status (read) bit will be one as long as the configuration bit is set. If this is set, the module will imitate one self calibration cycle. For subsequent self-calibration to occur, the bit must be cleared and reset or different configuration written to the card with this bit set.

Bit 4: Reserved for inter-module handshaking.

Bit 7: Reserved for Factory diagnosis.

Bit 8: This bit (read) indicates that the module has internal memory error. If this error is present, the internal error LED is lit.

Bit 9: This bit is set if bit 10 or 11 is set. If this bit is set, the internal error LED is lit. The Point Fault bit will be set as the condition of the module is undetermined. Also, I/O channel registers 2-9 will be in attention.

Bit 10: This bit (read) indicates that the module has internal memory error (FLASH checksum, Register or Static RAM error). Bit 9 will be set as well.

Bit 11: This bit indicates that the module is not calibrated. Bit 9 will be set as well.

Bit 13: Reserved for inter-module handshaking.

Bit 15: Bit indicates point fault status of the module. It is the logical "OR" of any individual channel error status bits in register C, plus bit 9 of this register. A "0" indicates that all eight points have good quality and no module error exists. When bit 9 of the Status Register is not set, this bit (when set to "1") indicates that at least one of the points has bad quality. A subsequent read of the Channel Error Register (address C) will reveal the point(s) that have bad quality. The Channel Error Register contains data only when the module fault is due to a bad point quality.

HART HP Analog Input Enable Register (Address 14 or E in Hex)

BIT	DATA DESCRIPTION - CONFIGURATION REGISTER (WRITE)	DATA DESCRIPTION - STATUS REGISTER (READ)
0	Multivariable Channel 1	Not Used
1	Multivariable Channel 2	Not Used
2	Multivariable Channel 3	Not Used
3	Multivariable Channel 4	Not Used
4	Multivariable Channel 5	Not Used
5	Multivariable Channel 6	Not Used
6	Multivariable Channel 7	Not Used
7	Multivariable Channel 8	Not Used
8	HART Enabled - Channel 1	Not Used
9	HART Enabled - Channel 2	Not Used
10	HART Enabled - Channel 3	Not Used
11	HART Enabled - Channel 4	Not Used
12	HART Enabled - Channel 5	Not Used
13	HART Enabled - Channel 6	Not Used
14	HART Enabled - Channel 7	Not Used
15	HART Enabled - Channel 8	Not Used

Bit 0-7: A "1" in any of these bits will cause Multivariable messaging on the corresponding channel.

Bit 8-15 A "1" in any of these bits indicate that a HART compliant device exists on the corresponding channel.

To avoid a HART communication error message, set each bit to “0” when connecting a non-HART output device.

The HART High Performance AI, HART High Performance AO, and IAH modules have the ability to retrieve additional variables from a field device. These variables are referred to as ‘multivariables’ and are named PV (primary variable), SV (secondary variable), TV (tertiary variable), and QV (quarterly variable).

14.6 DIAGNOSTIC LEDS

The following table lists the module’s LEDs and describes what they mean when lit.

HART HP Analog Input Diagnostic LEDs

LED	DESCRIPTION
P (Green)	Power OK LED. Illuminated when the +5V power is OK.
C (Green)	Communications OK LED. Illuminated when the Controller is communicating with the module.
I (Red)	Internal Error LED. Illuminated whenever there is any type of error within the module except for a loss of external auxiliary power. Possible causes are: ▪ The Controller sets the module’s Force Error bit. ▪ Communications with the Controller is lost. ▪ The module is not calibrated. ▪ Flash memory, EE memory or RAM diagnostic failure.
1-8 (Green)	The eight channel LEDs serve two functions. LEDs 1-8 are used to indicate the firmware state during module startup and are then used to indicate HART communications activity and analog input health during normal module operation. After module configuration, the bank of eight channel LEDs (LEDs 1-8) is used to indicate HART communications activity and the health of the analog input. If the Analog Input for the associated analog input channel is healthy (bit 15 set in the point data word), then the LED will be on. If the analog input channel is bad, then the LED will be off. When a HART message is sent and received correctly, the LED will blink off for 100 msec if the analog input is healthy. When a HART message is sent and received correctly, the LED will blink off for 400 msec if the analog input is healthy.

14.7 SPECIFICATIONS

Electronics Module (5X00106)

Personality Module (5X00109)

HART HP Analog Input Module Specifications

DESCRIPTION	VALUE
Number of channels	8
Input range	2.5 to 25 mA with under-range and over-range checking.
A/D Resolution	14 bits
Reference accuracy (@ 25oC)	+/-0.1% of full scale value (20mA) @ 99.7% confidence
Accuracy over temperature	+/-0.24% of full scale value (20mA) over the full operating temperature range
Sampling rate (per second)	20 when configured for 60 Hz rejection 25 when configured for 50 Hz rejection
Dielectric isolation: Channel to channel Channel to logic	 1000 VAC/VDC for one minute 1000 VAC/VDC for one minute
Operating temperature range	0o to 60oC (32oF to 140oF)
Humidity (non-condensing)	0% to 95%
Module power	Drawn from Main: 4.1W typical. 4.5W maximum Drawn from Aux.: 3.84W typical (20mA X 8 loops X 24V) Dissipation in module: 5.06W typ. (Emod + Pmod)
Input Impedance	300 ohms
Normal Mode Rejection	60 dB @50 Hz ± 1/2% or @60 Hz ± 1/2% (when properly configured) 30 dB (typical) @50 Hz ± 5% or @60 Hz ± 5% (when properly configured)
Common mode rejection	120 dB @ DC or @ the nominal (50/60 Hz) line frequency ± 1/2% and harmonics. 100 dB (typical) for nominal line frequency ± 5% and harmonics.

SECTION 15

HART ANALOG OUTPUT MODULE

IN THIS SECTION

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Wiring Information *211*
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Diagnostic LEDs *219*
Specifications *220*

15.1 DESCRIPTION

The Ovation HART (Highway Addressable Remote Transducer) Analog Output Module consists of an electronic module and a personality mode. The Ovation HART Analog Output Module is designed to interface with eight HART compliant output devices utilizing a 4-20 mA control loop signal. A HART compliant output device will exchange digital information with the Ovation control system in addition to the standard 4-20 mA control loop signal. The digital information is imposed on the 4-20 mA signal according to the guidelines of the HART Protocol Specification. HART uses a low-level frequency shift-keyed sine-wave signal that is superimposed on the 4-20 mA signal. The average value of the HART signal is zero. Therefore, the HART signal does not interfere with the 4-20 mA control signal.

The HART Analog Output module is applicable for CE Mark certified systems.

Note: *I/O Module General Information (see page 15) contains environmental, installation, wiring, and fuse information for I/O modules.*

15.2 MODULE GROUP INFORMATION

15.2.1 ELECTRONICS MODULE (EMOD)

There is one Electronics module group for the HART Analog Output Module:

- **5X00062G01** contains eight multiplexed, 4-20 mA output channels that interface with eight HART output devices.

15.2.2 PERSONALITY MODULE (PMOD)

There is one Personality Module group for the HART Analog Output Module:

- **5X00063G01** contains passive circuitry for each of the eight channels. There is a user-serviceable fuse located on the personality module. This fuses the auxiliary power supplying the field side circuitry of the eight output channels.

15.2.3 SUBSYSTEMS, HART ANALOG OUTPUT (14 BIT)

HART Analog Output Subsystems (14 Bit)

RANGE	CHANNELS	ELECTRONIC MODULE	PERSONALITY MODULE
4-20 mA	8	5X00062G01	5X00063G01
This configuration is CE Mark Certified.			

15.3 MODULE SPECIFIC INFORMATION

15.3.1 MODULE BLOCK DIAGRAMS

The Ovation HART analog output module assembly consists of two modules inserted into an Ovation base unit. The electronics module contains a logic printed circuit board (LHA) and a field printed circuit board (FHO). The simplified block diagram for the HART analog output electronics modules FHO board is shown in the following figure. The electronics module is used in conjunction with a personality module, which contains a single printed circuit board (PHAO).

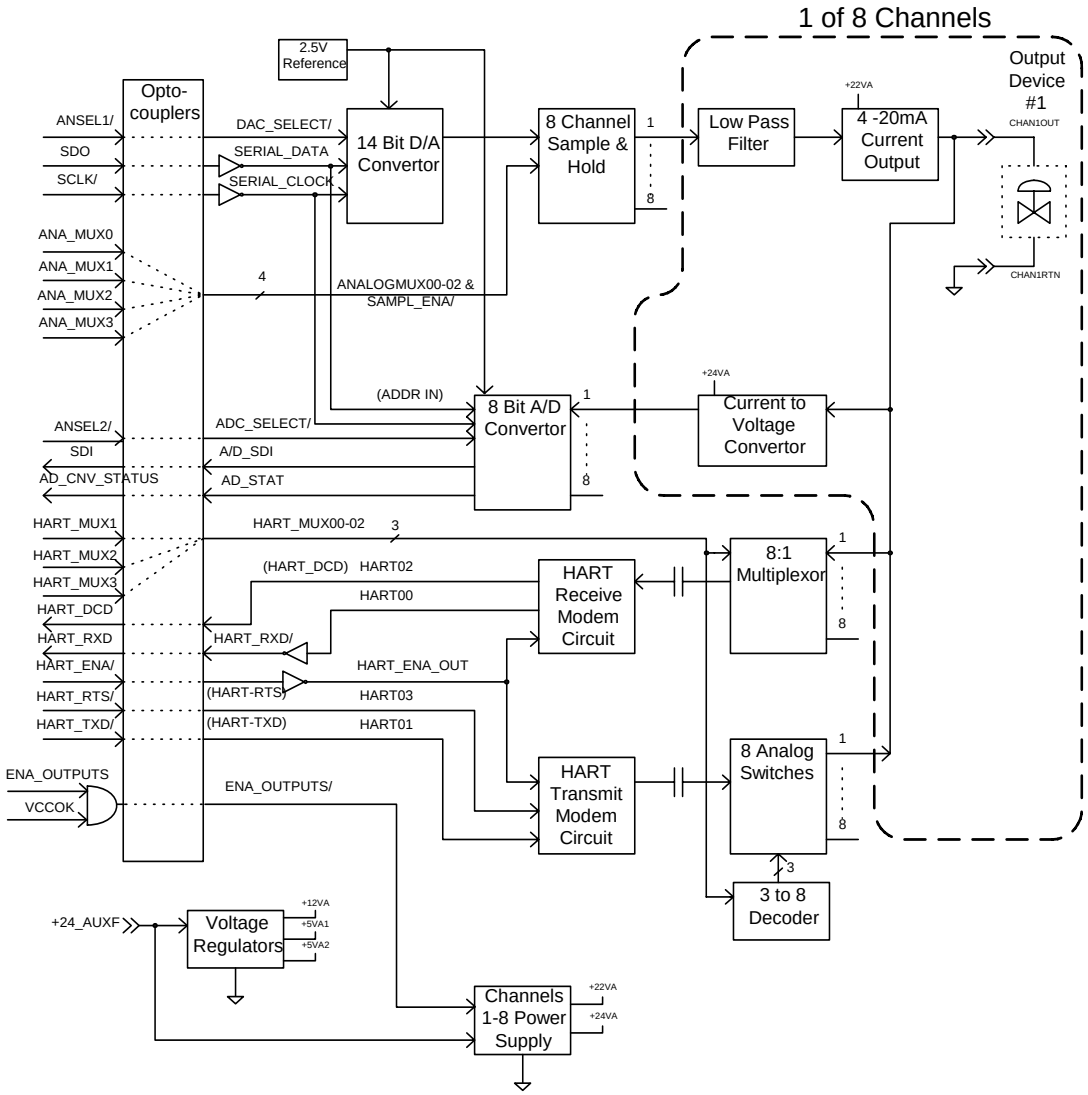


Figure 78: HART Analog Output Field Board Block Diagram

15.3.2 EXTERNAL POWER SUPPLIES

Note: *Module power specifications (main and auxiliary) refer to the actual power drawn by the module from the 24 VDC main power supply and from the +24 VDC auxiliary power supply and* ***NOT*** *from the AC or DC mains.*

The HART Analog Output Module utilizes the standard +24V Ovation main power supply to provide the power required for the logic circuitry.

The HART Analog Output Module utilizes a +24 auxiliary power supply to provide the power required for the field circuitry. This includes all 4-20 mA loop power, D/A conversion, and the remaining output channel components.

It is recommended that the HART Analog Output module utilize the Ovation cabinet's Auxiliary +24V DC power that is obtained from the standard Ovation DIN Rail power supply auxiliary output.

However, if an external auxiliary power supply is utilized by the HART Analog Input module, the power supply output noise cannot exceed 2.2 mVRMS maximum for all rated loads across the frequency range of 500 HZ to 10 kHZ .

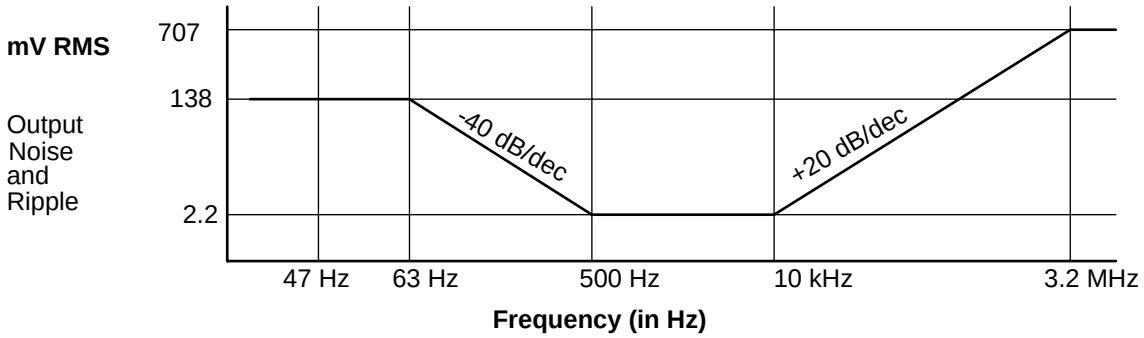


Figure 79: Power Supply Output Noise Requirements

If an external power supply is used, Using an External Power Supply (see page 539) contains steps to be undertaken before connecting the external power supply to the Ovation I/O base unit terminal block.

In addition, all modules utilizing the auxiliary power supplies, including the HART modules, **MUST** utilize shielded I/O cables in order to suppress coupled noise and transients into the HART modules. This includes modules on the same branch utilizing the auxiliary power, or modules on other branches utilizing the same auxiliary power. This recommendation applies regardless of the type of power supply chosen by the user.

15.4 WIRING INFORMATION

15.4.1 HART ANALOG OUTPUT TERMINAL BLOCK WIRING INFORMATION

Each personality module has a simplified wiring diagram label on its side which appears above the terminal block. This diagram indicates how the wiring from the field is to be connected to the terminal block in the base unit. The diagrams for the HART Analog Output Personality Modules are illustrated in the following figure. The following table lists and defines the abbreviations used in those diagrams.

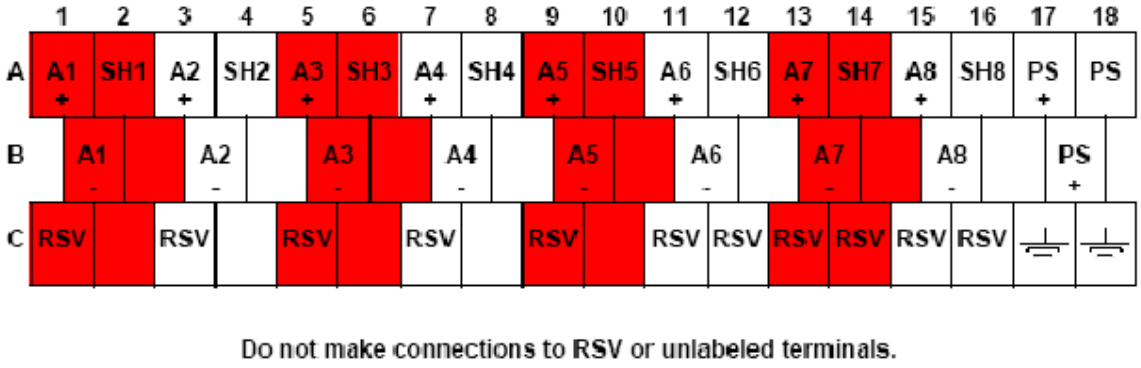
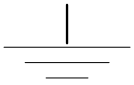

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18
A A1 + SH1 A2 + SH2 A3 + SH3 A4 + SH4 A5 + SH5 A6 + SH6 A7 + SH7 A8 + SH8 PS + PS
B A1 - A2 - A3 - A4 - A5 - A6 - A7 - A8 - PS +
C RSV RSV RSV RSV RSV RSV RSV RSV RSV RSV RSV RSV RSV RSV
Do not make connections to RSV or unlabeled terminals.

Figure 80: HART Analog Output Terminal Block Pin Assignments

Wiring Diagram Label Definitions

ABBREVIATION	DEFINITION
A1 - A8 +	Analog Output positive terminal connection (connected to the positive terminal of a HART analog output device).
A1 - A8 -	Analog Output negative terminal connection (connected to the negative terminal of a HART analog output device)
SH1 - SH8	Shield terminal connection
	Earth ground terminals
PS+, PS-	External Auxiliary power supply terminals

15.4.2 HART Analog Output Field Connection Wiring Diagrams (Non-CE Mark Certified Systems)

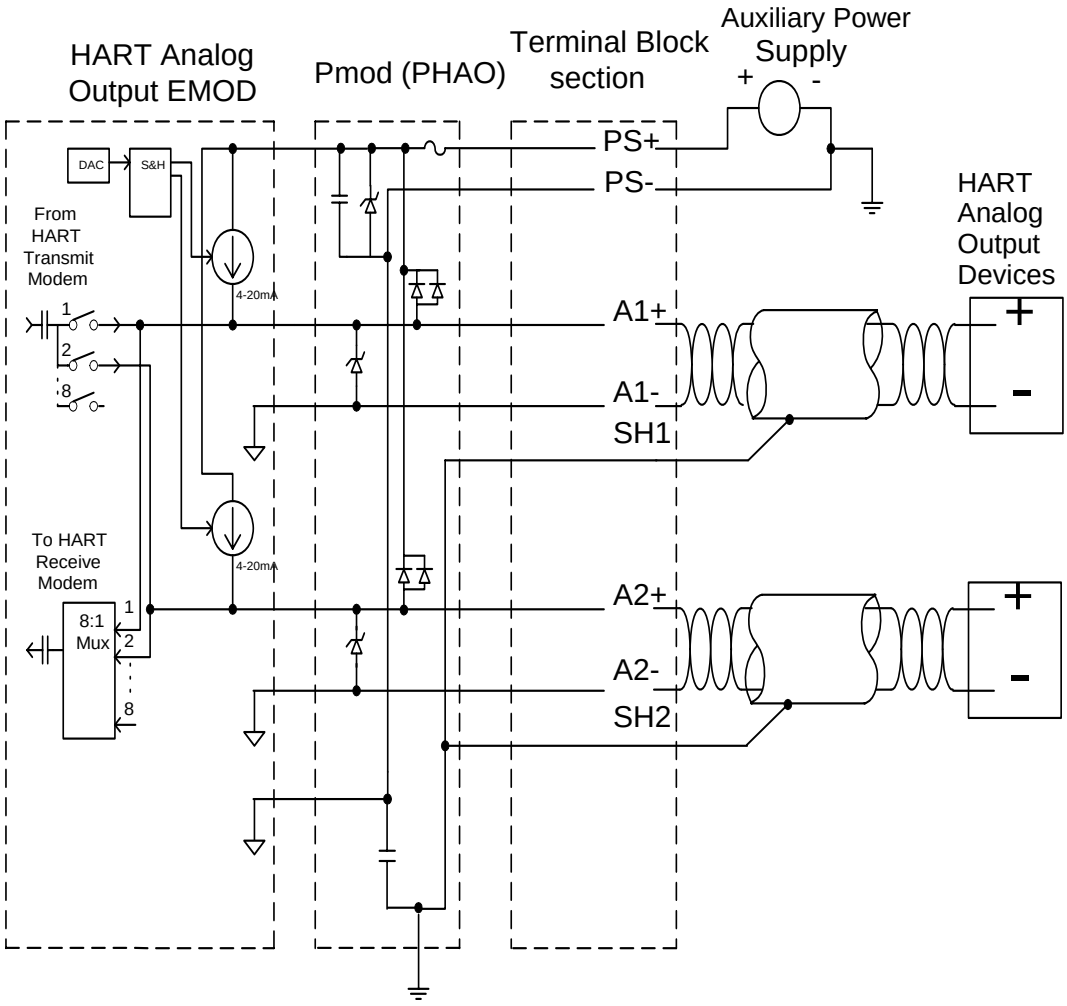
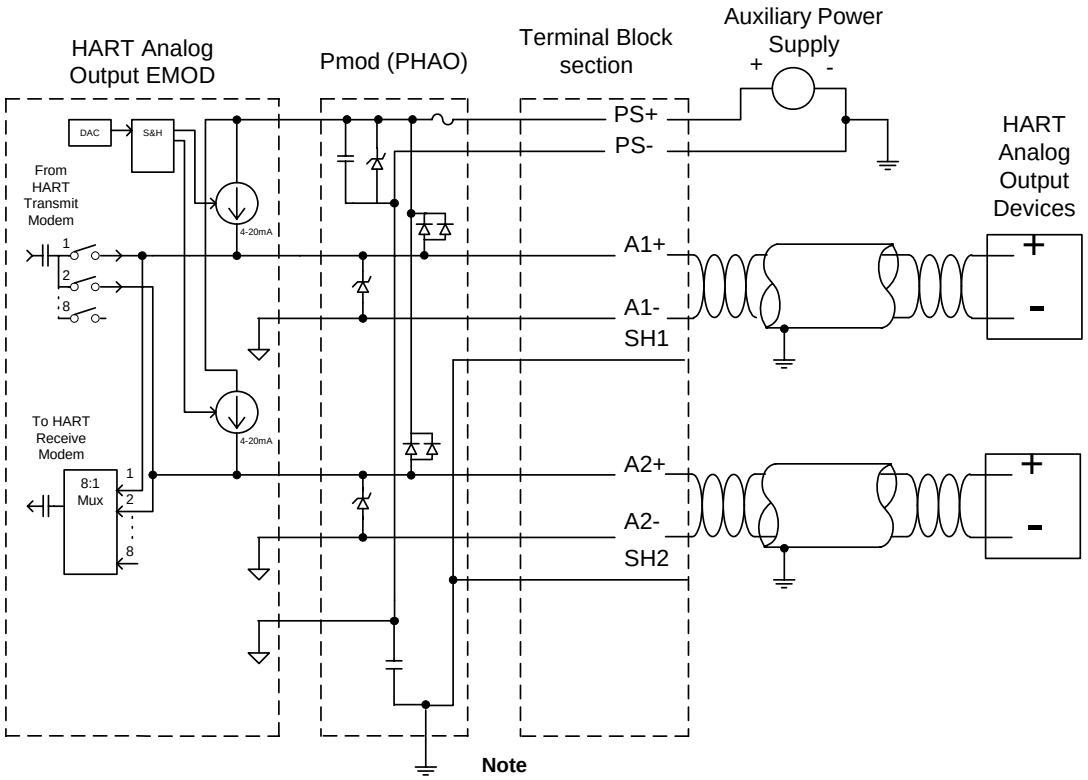


Figure 81: Field Wiring (Non-CE Mark) (2 of 8 channels depicted)

15.4.3 HART Analog Output Field Connection Wiring Diagrams (CE Mark Certified Systems)



Note

All field wiring must be braid-shielded and grounded at the point of entry of the cabinet using the recommended hardware (refer to the applicable "Cable Guidelines" information for your system).

Figure 82: Field Wiring (CE Mark) (2 of 8 channels depicted)

15.4.4 Field Wiring Cable Requirements

Field I/O cable must be one or more single-twisted pair shielded or multiple-twisted pair with overall shield. Single and multiple-pair may be combined provided that all of the shields share a common connection to earth ground in the Ovation cabinet.

Recommended Minimum Conductor Size

Cable Length	Min. Conductor Size	Cable Type
Below 5,000 feet (1524 m)	24 AWG (0.51 mm dia.)	Single-twisted pair shielded or multiple-twisted pair with over-all shield.
Above 5,000 (1524 m)	20 AWG (0.81 mm dia.)	Single-twisted pair shielded.

The maximum length of cable per HART network is dependent on the characteristics of the devices connected to the network and the characteristics of the cable to be used.

In a HART network, long cable lengths are possible when the dominant low impedance device (the HART field device) has an input impedance of approximately 250 ohms and the signal cable is good quality having low capacitance (Cx) and resistance (Rx) per unit length.

Cx = Cable capacitance per unit length (feet or meters): The capacitance from one conductor to all other conductors (including the shield if shielded). This value is usually available from the cable manufacturer.

Rx = Cable resistance per unit length (feet or meters): This value should be available from the cable manufacturer. Filed Wiring Requirements (see page 185) for the HART Analog Input Module contains the resistance values of some common copper wire sizes. The resistance per unit length is for a single wire but the length calculations and charts take into account the resistance of both wires.

Refer to field device manufacturer's literature for more information on cabling lengths since device impedances may vary among field devices. In addition, refer to the HART FSK Physical Layer Specification (HCF_SPEC - 54) for additional information.

15.5 Address Location Information

15.5.1 Configuration and Status Register

Word address 13 (D in Hex) is used to configure the module and provide status information to the Controller. The status register can be read by using the Point Information window at an Operator Station (see the Bit Pattern field on the Hardware tab). (See the *Ovation Operator Station User Guide.)*

HART Analog Output Register Map

Reg	Data Description - Configuration Register (Write)	Data Description - Status Register (Read)
0	Indirect Memory Index	NA
1	Indirect Memory Data	Indirect Memory Data
2	Analog Output - Channel 1	NA
3	Analog Output - Channel 2	NA
4	Analog Output - Channel 3	NA
5	Analog Output - Channel 4	NA
6	Analog Output - Channel 5	NA
7	Analog Output - Channel 6	NA
8	Analog Output - Channel 7	NA
9	Analog Output - Channel 8	NA
10	Calibration Register (Factory use only)	Calibration Register (Factory use only)

REG	DATA DESCRIPTION - CONFIGURATION REGISTER (WRITE)	DATA DESCRIPTION - STATUS REGISTER (READ)
11	NA	HAI Firmware Revision
12	NA	Channel Error Bits
13	Module Configuration Register	Module Status Register
14	NA	HART Enable (See the table below)
15	Module Electronic ID Data	NA

HART AO Configuration/Status Register (Address 13 or D in Hex)

BIT	DATA DESCRIPTION - (WRITE)	DATA DESCRIPTION - (READ)
0	Configure Module	Module Configured (1 = configured; 0 = unconfigured)
1	Force Error	Internal or forced error (1 = forced error; 0 = no forced error)
2 - 4	Communications Timeout Setting [1] BIT 4 / BIT 3 / BIT 2 / TIMEOUT 0 0 0 16 seconds 0 0 1 4 seconds 0 1 0 2 seconds 0 1 1 1 seconds 1 0 0 500 milliseconds 1 0 1 250 milliseconds 1 1 0 125 milliseconds 1 1 1 62.5 milliseconds	Communications Timeout Setting [1] BIT 4 / BIT 3 / BIT 2 / TIMEOUT 0 0 0 16 seconds 0 0 1 4 seconds 0 1 0 2 seconds 0 1 1 1 seconds 1 0 0 500 milliseconds 1 0 1 250 milliseconds 1 1 0 125 milliseconds 1 1 1 62.5 milliseconds
5	Timeout Action	NA
6	Reserved for Factory Test (must always be set to 0)	NA
7	Reserved for Factory Test (must always be set to 0)	NA
8	NA	Hardware Error
9	Not Used	Not Used
10	Not Used	Not Used
11	Not Used	Not Used
12	Not Used	Not Used
13	Not Used	Not Used
14	NA	Field Power Failed

BIT	DATA DESCRIPTION - (WRITE)	DATA DESCRIPTION - (READ)
15	Reserved	Reserved
[1] The tolerance on the timeout period is +/- 35%.		

Bit definitions for this register are encoded as shown above and described below:

Bit 0: Configures the module (write) or indicates the configuration state of the module (read). A “1” indicates that the module is configured. Until the module is configured, addresses 0 through 11 will produce an attention status.

Bit 1: This bit (write “1”) forces the module into its error state causing the Internal Error LED to light.

Bits 2-4: These bits are used to select the Controller communications timeout period.

Bit 5: If this bit is set and the Controller times out, the module will continue to output the last value received. If the bit is cleared and the Controller times out, the module will output zero to the DAC for each channel, yielding 0 mA on the outputs after the time out period defined by bits 2-4.

Bits 6-7: Reserved for use by the Factory Test. These bits must always be set to 0.

Bit 8: When set, this indicates one or more of the following conditions are true:

- The FPGA did not program correctly upon startup.
- The EE memory checksum is incorrect.
- The PROM checksum test has failed.
- Internal memory diagnostic has failed.

Bits 9-13: Not Used.

Bit 14: Field power failed.

Bit 15: Reserved.

HART Analog Output Enable Register (Address 14 or E in Hex)

BIT	DATA DESCRIPTION - CONFIGURATION REGISTER (WRITE)	DATA DESCRIPTION - STATUS REGISTER (READ)
0	Multi-variable Enabled	NA
1	Multi-variable Enabled	NA
2	Multi-variable Enabled	NA
3	Multi-variable Enabled	NA
4	Multi-variable Enabled	NA
5	Multi-variable Enabled	NA
6	Multi-variable Enabled	NA
7	Multi-variable Enabled	NA
8	HART Enabled - Channel 1	NA
9	HART Enabled - Channel 2	NA

BIT	DATA DESCRIPTION - CONFIGURATION REGISTER (WRITE)	DATA DESCRIPTION - STATUS REGISTER (READ)
10	HART Enabled - Channel 3	NA
11	HART Enabled - Channel 4	NA
12	HART Enabled - Channel 5	NA
13	HART Enabled - Channel 6	NA
14	HART Enabled - Channel 7	NA
15	HART Enabled - Channel 8	NA

Bits 0-7: These bits are set to enable multivariable messaging.

The HAI, HAO, HART High Performance AI and HART High Performance AO modules have the ability to retrieve additional variables from a field device. These variables are referred to as 'multivariables' and are named PV (primary variable), SV (secondary variable), TV (tertiary variable), and QV (quarterly variable).

If the bit is set, the module will periodically retrieve whatever variables exist for the device.

The definitions of PV, SV, TV, and QV are found in the user's manual for the field device supplied by the device manufacturer. The standard format of these four variables is IEEE 794, a floating-point format.

You must configure IO point records to cause the Controller to scan the module and retrieve the variables. (See the *Ovation Point Builder User Guide* or *Ovation Developer Studio User Guide*.).

Bits 8-15: In the IO configuration tool, you can set these flags on a per-channel basis to allow HART messaging, including Multivariable messaging, to flow on that channel.

15.5.2 OPEN LOOP DETECT REGISTER

If one of these bits is set, the channel readback diagnostic indicates the difference between the desired value and the actual value exceeds the accepted deadband. This bit signifies an open loop condition.

Pass/Fail per Channel Register (Address 12 or C in Hex)

BIT	DATA DESCRIPTION - CONFIGURATION REGISTER (WRITE)	DATA DESCRIPTION - STATUS REGISTER (READ)
0	NA	Channel 1 bad
1	NA	Channel 2 bad
2	NA	Channel 3 bad
3	NA	Channel 4 bad
4	NA	Channel 5 bad
5	NA	Channel 6 bad
6	NA	Channel 7 bad

BIT	DATA DESCRIPTION - CONFIGURATION REGISTER (WRITE)	DATA DESCRIPTION - STATUS REGISTER (READ)
7	NA	Channel 8 bad
8	Not Used	Not Used
9	Not Used	Not Used
10	Not Used	Not Used
11	Not Used	Not Used
12	Not Used	Not Used
13	Not Used	Not Used
14	Not Used	Not Used
15	Not Used	Not Used

HART Analog Output Enable Register (Address 14 or E in Hex)

BIT	DATA DESCRIPTION - CONFIGURATION REGISTER (WRITE)	DATA DESCRIPTION - STATUS REGISTER (READ)
0	Multi-variable Enabled - Channel 1	Not used
1	Multi-variable Enabled - Channel 2	Not used
2	Multi-variable Enabled - Channel 3	Not used
3	Multi-variable Enabled - Channel 4	Not used
4	Not used	Not used
5	Not used	Not used
6	Not used	Not used
7	Not used	Not used
8	HART Enabled - Channel 1	Not used
9	HART Enabled - Channel 2	Not used
10	HART Enabled - Channel 3	Not used
11	HART Enabled - Channel 4	Not used
12	Not used	Not used
13	Not used	Not used
14	Not used	Not used
15	Not used	Not used

Bit definitions for this register are encoded as shown above and described below:

Bits 0-3:These bits in the Configuration Register are set to enable multivariable messaging.

The LOH module has the ability to retrieve additional variables from a field device. These variables are referred to as 'multivariables' and are named PV (primary variable), SV (secondary variable), TV (tertiary variable), and QV (quarterly variable).

If the bit is set, the module will periodically retrieve whatever variables exist for the device.

The definitions of PV, SV, TV, and QV are found in the user's manual for the field device supplied by the device manufacturer. The standard format of these four variables is IEEE 794, a floating-point format.

You must configure IO point records to cause the Controller to scan the module and retrieve the variables. For additional information refer to the applicable *Ovation Point Builder User Guide* for your system.

Bits 4 - 7: Not used.

Bits 8-15: A "1" in any of these bits in the Status Register indicate that a HART compliant device exists on the corresponding channel.

You should ensure that these bits are cleared for non-HART field devices. To avoid a HART communication error message, set each bit at "0" when connecting a non-HART output device.

15.6 DIAGNOSTIC LEDS

The following table lists the module's LEDs and describes what they mean when lit.

HART Analog Output LEDs

LED	DESCRIPTION
P (Green)	Power OK LED. Illuminated when the +5V power is OK.
C (Green)	Communications OK LED. Illuminated when the Controller is communicating with the module.
E (Red)	External Error LED. Illuminated upon loss of external auxiliary (field) power, as indicated by the loss of normal transitions of the EOC (end-of-convert) signal.
I (Red)	Internal Error LED. Illuminated whenever there is any type of error within the module except for a loss of external auxiliary power. Possible causes are: - The Controller sets the module's Force Error bit. - Communications with the Controller is lost. - EPROM, EE memory or RAM diagnostic failure.

LED	DESCRIPTION
1-8 (Green)	After module configuration, the bank of eight channel LEDs (LEDs 1 through 8) is used to indicate HART communication activity. When a HART message is sent, the LED for that particular channel is illuminated. When the HART response is received correctly, the LED is extinguished. Therefore, when all is normal, that is, messages and responses are properly exchanged, a single LED blink will be observed on the module's front cap. If a HART message is sent and no response is received, the HART Analog Output module exclusive-OR's the channel LED display with hex code 0xFF. This results in all channel LEDs being illuminated except for the selected channel. For example, if the HART Analog Output module sent a HART message to a device on channel 2, but the device was not connected to channel 2, the module would first illuminate LED 2 (all seven other channel LEDs extinguished). The module would then extinguish LED 2 and flash the other seven channel LEDs. This status indicates that the module sent a HART message on channel 2 and did not receive a valid response message after the initial message attempt or after any of the subsequent message retries.

15.7 SPECIFICATIONS

Electronics Module (5X00062)

Personality Module (5X00063)

HART Analog Output Channel Specifications

DESCRIPTION	VALUE
Number of channels	8
Channel Update Rate	24 mS (Each channel is updated once every 24 mS by the on-board microcontroller, 14 Bit resolution typ.)
Output Range	4 to 20 mA
D/A Resolution	14 Bits
Accuracy over Temperature Range	0.25% of Span
User Loop Voltage	Power for loop current is supplied through the module by an auxiliary power supply.
Diagnostics	Open loop feedback detection. 8 Pass/Fail bits are stored in data register 0xC in Hex.
Dielectric isolation: Channel to Channel Channel to logic	 None 1000 VAC/VDC for 1 minute.
Output Loading	4-20 mA into 700 ohm load maximum (230 ohm minimum to 600 ohm maximum).[1]
Output Compliance	20 mA@21.6 VDC Supply into 700 ohm load.

DESCRIPTION	VALUE
Operating Temperature Range	0o to 60o C
Humidity (non-condensing)	0% to 95%
Module Power	Main: 24 VDC 1.2 W typical, 2.5W maximum Aux: 24 VDC (-5%,+6.25%) 6W typical, 7.2W maximum
[1] Per the HART Physical Layer Specification (HCF_SPEC - 54).	

SECTION 16

HART HIGH PERFORMANCE ANALOG OUTPUT MODULE

IN THIS SECTION

Description *223*
Module Group Information *223*
Module Specific Information *225*
Wiring Information *226*
Address Location Information *229*
Diagnostic LEDs *233*
Specifications *234*

16.1 DESCRIPTION

The Ovation HART High Performance Analog Output Module consists of an electronic module and a personality mode cavity insert. The Ovation HART High Performance Analog Output Module is designed to interface with four HART compliant output devices utilizing a 4-20 mA control loop signal. A HART compliant output device will exchange digital information with the Ovation control system in addition to the standard 4-20 mA control loop signal. The digital information is imposed on the 4-20 mA signal according to the guidelines of the HART Protocol Specification. HART uses a low-level frequency shift-keyed sine-wave signal that is superimposed on the 4-20 mA signal. The average value of the HART signal is zero. Therefore, the HART signal does not interfere with the 4-20 mA control signal.

Note: *I/O Module General Information (see page 15) contains environmental, installation, wiring, and fuse information for I/O modules.*

16.2 MODULE GROUP INFORMATION

16.2.1 ELECTRONICS MODULE (EMOD)

There is one Electronics module group for the HART High Performance Analog Output Module:

- **5X00167G01** contains four independent self-powered, 4-20 mA output channels that interface with 4 HART output devices.

16.2.2 SUBSYSTEMS, HART ANALOG OUTPUT (16 BIT)

HART Analog Output Subsystems (16 Bit)

SPAN	CHANNELS	ELECTRONIC MODULE	PERSONALITY MODULE
4-20 mA	4	5X00167G01	Cavity Insert 1X00188H01

A personality module is not required in order to use the HART High Performance Analog Output module. However, there may be requirements to use the Ovation Analog Output module base unit terminal assignments for the actuator interface field wiring. In those cases, the 5X00170G01 HART High Performance Analog Output personality module must be used.

16.3 MODULE SPECIFIC INFORMATION

16.3.1 MODULE BLOCK DIAGRAMS

The Ovation HART High Performance Analog Output module assembly consists of one module inserted into an Ovation base unit. The electronics module contains a logic printed circuit board (LOH) and a field printed circuit board (FOH). The simplified block diagram for the HART High Performance Analog Output electronics modules FOH board is shown in the following two figures. The electronics module is used in conjunction with a personality module cavity insert which plugs into the base unit cavity normally occupied by a personality module.

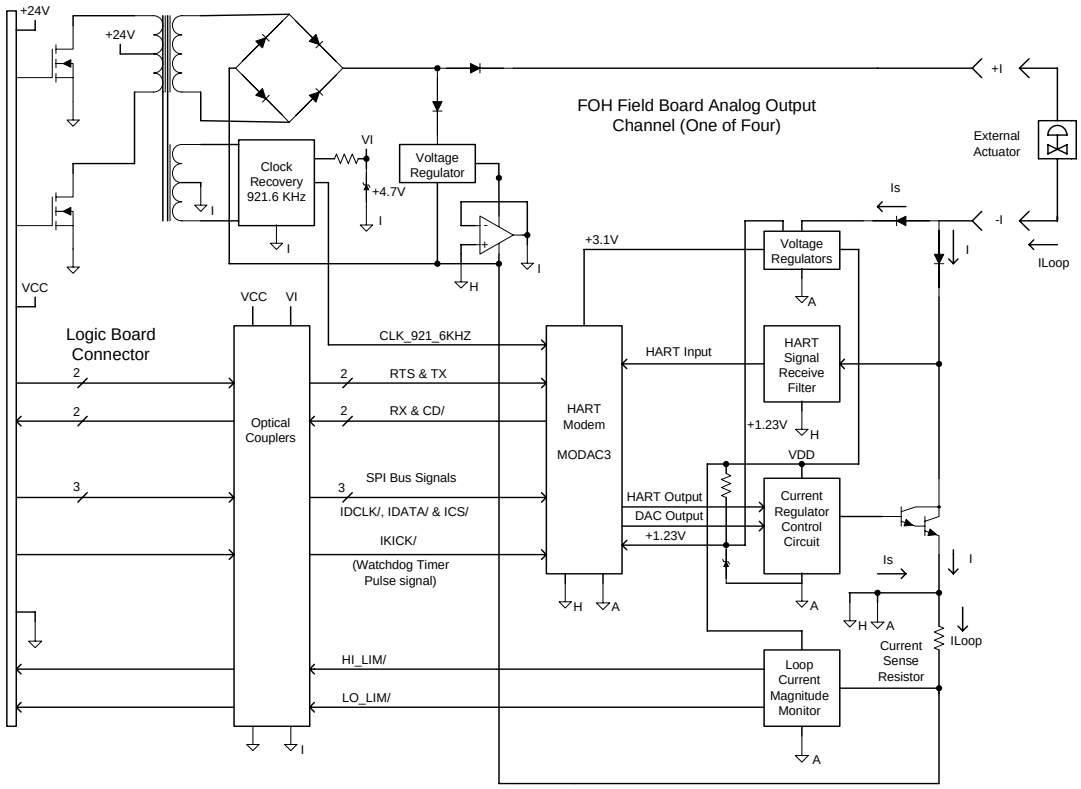


Figure 83: HART High Performance Analog Output Field Board Block Diagram (with 1X00188H01 Personality Module Cavity Foam Insert Present)

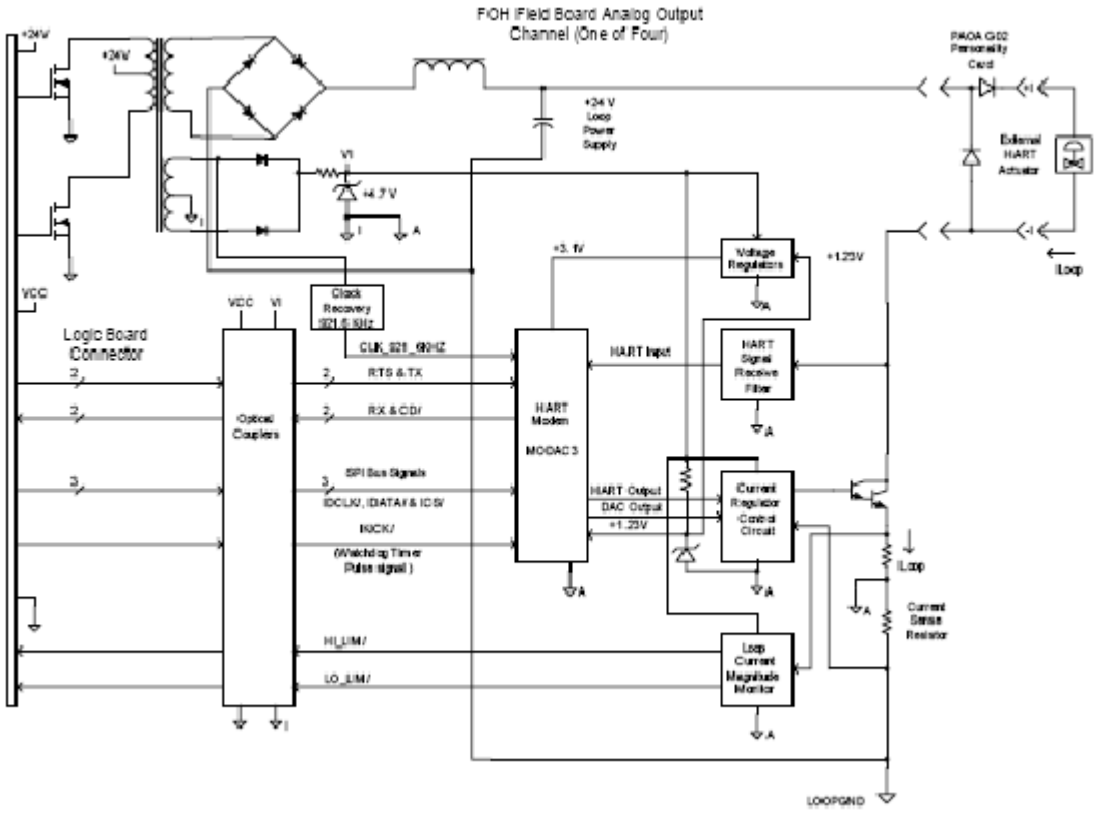


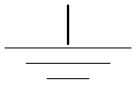
Figure 84: HART High Performance Analog Output Field Board Block Diagram (5X00170G01 Personality Module Present)

16.4 WIRING INFORMATION

16.4.1 OUTPUT TERMINAL BLOCK WIRING INFORMATION

Each personality module cavity insert has a simplified wiring diagram label on its top which appears above the terminal block. This diagram indicates how the wiring from the field is to be connected to the terminal block in the base unit. The wiring diagrams for the HART High Performance Analog Output Personality Modules are illustrated in HART Analog Output Field Connection Wiring Diagrams.

Abbreviations Used in Diagrams

ABBREVIATION	DEFINITION
+I	Analog Output positive terminal connection (connected to the positive terminal of a HART analog output device).
-I	Analog Output negative terminal connection (connected to the negative terminal of a HART analog output device)
	Earth ground terminals

ABBREVIATION	DEFINITION
PS+, PS-	External Auxiliary power supply terminals (Not Used)

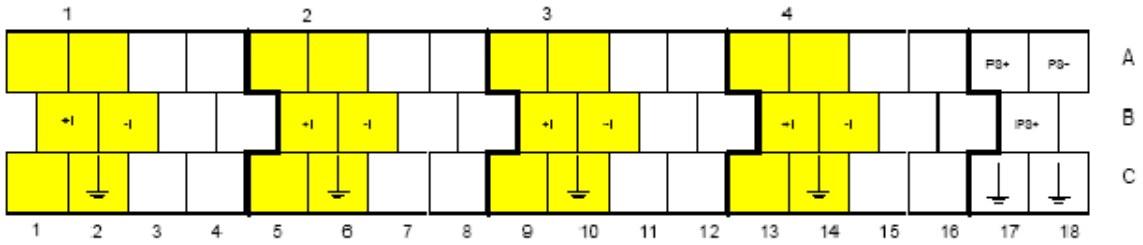


Figure 85: Terminal Block Pin Assignments with 1X00188H01 Personality Module Foam Cavity insert Present

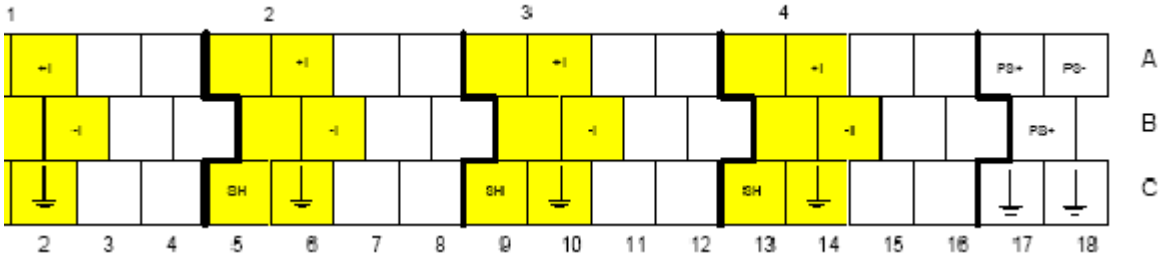


Figure 86: Terminal Block Pin Assignments with 5X00170G01 Personality Module Present

16.4.2 HART H.P. Analog Output Field Wiring Connections with Personality Module Foam Cavity Insert (Non-CE Mark Certified System)

16.4.3 HART H. P. Analog Output Field Wiring Connections with Personality Module (Non-CE Mark Certified System)

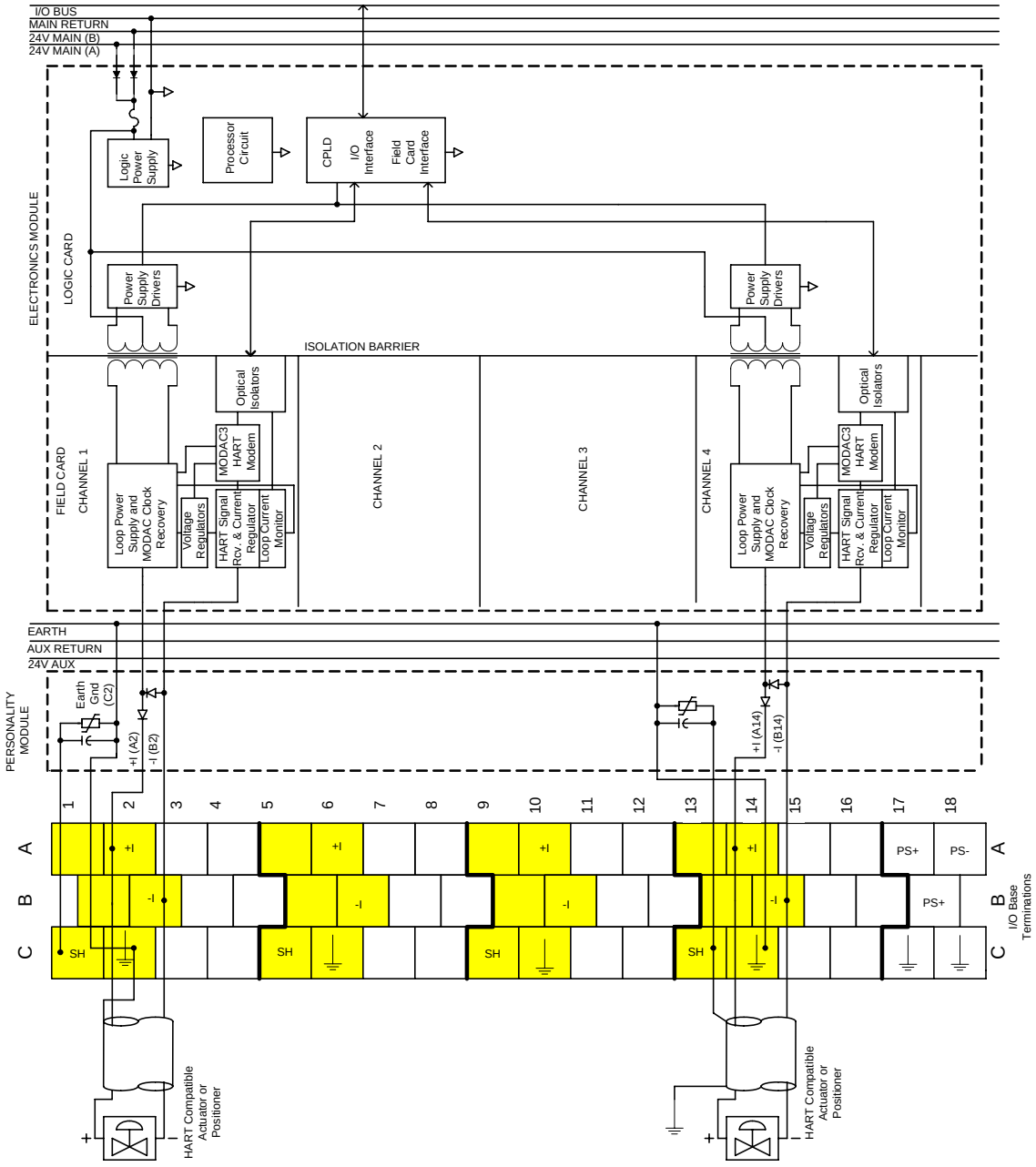


Figure 87: HART High Performance Analog Output Field Wiring Connections with Personality Module (2 of 4 channels depicted) Non-CE Mark Certified System

16.4.4 Field Wiring Cable Requirements

Field I/O cable must be one or more single-twisted pair shielded or multiple-twisted pair with overall shield. Single and multiple-pair may be combined provided that all of the shields share a common connection to earth ground in the Ovation cabinet.

Recommended Minimum Conductor Size

Cable Length	Min. Conductor Size	Cable Type
Below 5,000 feet (1524 m)	24 AWG (0.51 mm dia.)	Single-twisted pair shielded or multiple-twisted pair with over-all shield.
Above 5,000 (1524 m)	20 AWG (0.81 mm dia.)	Single-twisted pair shielded.

The maximum length of cable per HART network is dependent on the characteristics of the devices connected to the network and the characteristics of the cable to be used.

16.5 Address Location Information

16.5.1 HART High Performance Analog Output Module Registers

HART Analog Output Register Map

Reg	Data Description - Configuration Register (Write)	Data Description - Status Register (Read)
0	Indirect Memory Index	NA
1	Indirect Memory Data	Indirect Memory Data
2	Analog Output - Channel 1	NA
3	Analog Output - Channel 2	NA
4	Analog Output - Channel 3	NA
5	Analog Output - Channel 4	NA
6	Not Used	Not Used
7	Not Used	Not Used
8	Not Used	Not Used
9	Not Used	Not used
10	Reserved	Reserved
11	NA	LOH Firmware Revision
12	NA	Channel Error Bits
13	Module Configuration Register	Module Status Register
14	NA	Multivariable Enable/HART Enable

REG	DATA DESCRIPTION - CONFIGURATION REGISTER (WRITE)	DATA DESCRIPTION - STATUS REGISTER (READ)
15	Module Electronic ID Data	NA

Configuration and Status Register

Word address 13 (D in Hex) is used to write to the Module Configuration Register and to read the Module Status Register. The status register can be read by using the Point Information window at an Operator Station (see the Bit Pattern field on the Hardware tab). (See the *Ovation Operator Station User Guide.)*

Configuration/Status Register (Address 13 or D in Hex)

BIT	DATA DESCRIPTION - (WRITE)	DATA DESCRIPTION - (READ)
0	Configure Module	Module Configured (1 = configured; 0 = unconfigured)
1	Force Error	Internal or forced error (1 = forced error; 0 = no forced error)
2	Communication Timeout bit 0	NA
3	Communication Timeout bit 1	NA
4	Communication Timeout bit 2	NA
5	Timeout Action	NA
6	Factory Test	Not Used
7	Reserved	Reserved
8	NA	Channel 1 - over-under
9	NA	Channel 2 - over-under
10	NA	Channel 3 - over-under
11	NA	Channel 4 - over-under
12	Not Used	Not Used
13	Not Used	Not Used
14	Not Used	Not Used
15	Not Used	Not Used

Bit 0: Configures the module (write) or indicates the configuration state of the module (read). “1” indicates that the module is configured. Until module is configured, addresses 0 through 11 will produce an attention status.

Bit 1: This bit (write “1”) forces the module into its error state causing the Internal Error LED to light.

Bits 2-4: These bits are used to select the Controller communications timeout period.

Bit 5: If this bit is set and the Controller times out, the module will continue to output the last value received. If the bit is cleared and the Controller times out, the module will output data to the DAC for each channel, that yields 4mA on the outputs after the time-out period defined by bits 2-4.

Bit 6: This bit is only used in the manufacturing test. When the bit is set and PE is active, the module enters a factory test mode.

Bits 7: Reserved.

Bit 8: 1=Channel 1 output current is overrange or underrange.

Bit 9: 1=Channel 2 output current is overrange or underrange.

Bit 10: 1=Channel 3 output current is overrange or underrange.

Bit 11: 1=Channel 4 output current is overrange or underrange.

Bits 12-15: Not Used.

Output Communication Timeout Settings

TIMEOUT BIT 2	TIMEOUT BIT 1	TIMEOUT BIT 0	TIMEOUT PERIOD
0	0	0	16 seconds
0	0	1	4 seconds
0	1	0	2 seconds
0	1	1	1 second
1	0	0	500 milliseconds
1	0	1	250 milliseconds
1	1	0	125 milliseconds
1	1	1	62 milliseconds
Time-outs have a tolerance of +/- 35%. The default after a power-up is 16 seconds is.			

Channel Error Bit

The following table is for reference only, Individual bits are not user accessible.

Over/Under Current Limit Register (Address 12 or C in Hex)

BIT	DATA DESCRIPTION - CONFIGURATION REGISTER (WRITE)	DATA DESCRIPTION - STATUS REGISTER (READ)
0	NA	Channel 1 Under Current
1	NA	Channel 2 Under Current
2	NA	Channel 3 Under Current
3	NA	Channel 4 Under Current
4	NA	Channel 1 Over Current

BIT	DATA DESCRIPTION - CONFIGURATION REGISTER (WRITE)	DATA DESCRIPTION - STATUS REGISTER (READ)
5	NA	Channel 2 Over Current
6	NA	Channel 3 Over Current
7	NA	Channel 4 Over Current
8	Not Used	Not Used
9	Not Used	Not Used
10	Not Used	Not Used
11	Not Used	Not Used
12	Not Used	Not Used
13	Not Used	Not Used
14	Not Used	Not Used
15	Not Used	Not Used

Enable Register (Address 14 or E in Hex)

BIT	DATA DESCRIPTION - CONFIGURATION REGISTER (WRITE)	DATA DESCRIPTION - STATUS REGISTER (READ)
0	Multi-variable Enabled - Channel 1	NA
1	Multi-variable Enabled - Channel 2	NA
2	Multi-variable Enabled - Channel 3	NA
3	Multi-variable Enabled - Channel 4	NA
4	Not Used	Not Used
5	Not Used	Not Used
6	Not Used	Not Used
7	Not Used	Not Used
8	HART Enabled - Channel 1	NA
9	HART Enabled - Channel 2	NA
10	HART Enabled - Channel 3	NA
11	HART Enabled - Channel 4	NA
12	Not Used	Not Used
13	Not Used	Not Used
14	Not Used	Not Used
15	Not Used	Not Used

Bits 0-3: These bits are set to enable multivariable messaging. Refer to the IO configuration guide for additional information.

The HAI, HAO, HART High Performance AI, HART High Performance AO modules have the ability to retrieve additional variables from a field device. These variables are referred to as 'multivariables' and are named PV (primary variable), SV (secondary variable), TV (tertiary variable), and QV (quarterly variable).

If the bit is set, the module will periodically retrieve whatever variables exist for the device.

The definitions of PV, SV, TV, and QV are found in the user's manual for the field device supplied by the device manufacturer. The standard format of these four variables is IEEE 794, a floating-point format.

You must configure IO point records to cause the Controller to scan the module and retrieve the variables. (See *Ovation Point Builder* or *Ovation Developer Studio User Guide*.)

Bits 8-11: In the IO configuration tool, you can set these flags on a per-channel basis to allow HART messaging, including Multivariable messaging, to flow on that channel.

You should ensure that these bits are cleared for non-HART field devices. To avoid a HART communication error message, set each bit at "0" when connecting a non-HART output device.

16.6 DIAGNOSTIC LEDS

The following table lists the module's LEDs and describes what they mean when lit.

HART High Performance Analog Output LEDs

LED	DESCRIPTION
P (Green)	Power OK LED. Illuminated when the +5V power is OK.
C (Green)	Communications OK LED. Illuminated when the Controller is communicating with the module.
I (Red)	Internal Error LED. Illuminated whenever there is any type of error within the module except for a loss of external auxiliary power. Possible causes are: - The Controller sets the module's Force Error bit. - Communications with the Controller is lost. - Flash Memory, EE memory or RAM diagnostic failure.
1-4 (Green)	After module configuration, the bank of four channel LEDs (LEDs 1 through 4) is used to indicate HART communication activity and the health of the analog outputs. If the analog output for the associated analog output channel is healthy (no overcurrent or undercurrent condition), then the channel LED will be ON. If the analog output channel is bad (an overcurrent or undercurrent is present), then the channel LED will be off. When a HART message is sent and received correctly, the channel LED will blink off for 100 msec if the analog output is healthy. When a HART message is sent and received incorrectly, the channel LED will blink off for 400 msec if the analog output is healthy.

16.7 SPECIFICATIONS

HART High Performance Analog Output Channel Specifications

DESCRIPTION	VALUE
Number of channels	4
Maximum Update Time	33 mSec.
Output Range	4 to 20 mA nominal signal voltage (Span) 0 to 23.5 mA (full signal range)
D/A Resolution	16 Bits.
Reference Accuracy Temperature Range	0.10% of full scale (20mA) @25o C
Temperature Coefficient	25ppm of full scale / o C
Current Loop Power	For each channel, power for loop current is supplied by the module
Diagnostics	Loop Current Overrange/Underrange detection. Eight Error bits are stored in data register 0xC in Hex (Address 12)
Dielectric isolation: Channel to Channel Channel to logic	 1000 VAC/VDC for 1 minute 1000 VAC/VDC for 1 minute
Output Loading	4-20 mA (230 ohm minimum to 600 ohm maximum)[1]
Operating Temperature Range	0o to 60o C (32o to 140o F)
Storage Temperature Range	-40o to 85o C (-40o to 185o F)
Humidity (non-condensing)	0% to 95%
Module Power	Main: 24 VDC 4.56W nominal, 6.75W Max Aux: 24 VDC Not Used.
[1] Per the HART Physical Layer Specification (HCF_SPEC - 54).	

SECTION 17

LINK CONTROLLER (LC) MODULE

IN THIS SECTION

Description *235*
Module Group Information *235*

17.1 DESCRIPTION

The Link Controller (LC) module provides the Ovation Controller with a serial data communications link to a third-party device or system. This communication is done via a serial RS-232, RS-422, or RS-485 data link. Two serial ports are provided.

This module is not described in this document. (See *Ovation LC Module Interface User Guide*.)

The Link Controller Module is applicable for CE Mark Certified Systems.

Note: *I/O Module General Information (see page 15) contains environmental, installation, wiring, and fuse information for I/O modules.*

17.2 MODULE GROUP INFORMATION

17.2.1 ELECTRONICS MODULE (EMOD)

There is one Electronics module group for the Link Controller Module:

- **1C31166G01** provides for communication to a third-party device or system.

17.2.2 PERSONALITY MODULES (PMODS)

There are two Personality module groups for the Link Controller Module:

- **1C31169G01** provides for an RS-232 serial link (in CE Mark certified systems, the application port cable must be less than 10 meters (32.8 ft)).
- **1C31169G02** provides for an RS-485 serial link (also may be used to provide for an RS-422 serial link).

17.2.3 SUBSYSTEMS, LINK CONTROLLER

Link Controller Subsystems[1]

RANGE	CHANNELS	ELECTRONIC MODULE	PERSONALITY MODULE
RS232	One (1) Serial Port (Able to handle many points)	1C31166G01	1C31169G01
RS485/RS422 Four wire	One (1) Serial Port (Able to handle many points)	1C31166G01	1C31169G02

[1] To use this module, the appropriate SLC algorithm must reside in the Ovation Controller. (See *Ovation Algorithm Reference Manual*.)

SECTION 18

LOOP INTERFACE MODULE

IN THIS SECTION

Description *237*
Module Group Information *238*
Module Specific Information *241*
Wiring Information *243*
Address Location Information *260*
Diagnostic LEDs *262*
Specifications *264*

18.1 DESCRIPTION

The Ovation single-loop Controller is designed to interface to the analog and digital I/O necessary to control a single process loop. In addition, the Ovation single-loop Controller displays this process information and provides for manual control via a local operator interface station.

The Ovation single-loop interface module provides the following field inputs and outputs necessary to interface to a single loop:

- Two individually isolated analog inputs.
- One isolated analog output.
- Two individually isolated digital inputs.
- Two isolated digital outputs (the outputs share a common ground with each other, but are isolated from the other I/O circuits and from the logic portion of the module).

In addition, the single-loop interface module contains an RS-422 serial port for communications with a loop interface module (SLIM) and an interface for communications over the Ovation serial I/O bus.

The Loop Interface Module is applicable for CE Mark Certified Systems.

Note: *I/O Module General Information (see page 15) contains environmental, installation, wiring, and fuse information for I/O modules.*

18.2 MODULE GROUP INFORMATION

18.2.1 MODULE GROUPS

There are two basic styles of single-loop interface modules, Normal (non-electric drive) and Electric Drive:

- **Normal (non-electric drive) Type** - This type of module calculates the process variable for display at the SLIM by converting analog input 1 to engineering units. The output to the field is the analog output. This type of module may use a group 1, 2, or 3 Electronics module.
- **Electric Drive Type** - Two types of Electric Drive modes are supported. Electric Drive module types are available with group 4 Electronics modules only. The mode of the Electric Drive is controlled through software.
  - **Electric Drive Type (Mode 1)**
    This type of module calculates the process variable from analog input 1, and the output (Demand) is calculated by the Controller as in Normal (non-electric drive) card styles. However, the output to the field are the two digital outputs. The output (Demand) from the Controller is compared to the process position (analog input 2), and raise and output pulses are generated accordingly to control the process. Digital output 1 corresponds to raise and digital output 2 corresponds to lower. The outputs are pulsed with the duty cycle proportional to the speed of the raise or lower action. The raise/lower ON/OFF times are specified in the control algorithm.
  - **Electric Drive Type (Mode 2)**
    As in Electric Drive (Mode 1), this type of module calculates the process variable from analog input 1, and its field output are two digital outputs. However, in all operating modes except Local, a demand of zero (0) will force a hard (non-pulsing) lower. This means that digital output 2 will be forced active LOW and will remain LOW until the demand is not equal to 0. Local mode operation is unchanged.

18.2.2 ELECTRONIC MODULES (EMODS)

There are four groups of Electronics modules for the Loop Interface Module:

- **1C31174G01** provides analog inputs 0 to +10V, and analog outputs 0 to +10V, digital inputs 24/48 VDC and digital outputs 60 VDC.
- **1C31174G02** provides analog inputs 0 to +5V, and analog outputs 0 to +10V, digital inputs 24/48 VDC and digital outputs 60 VDC.
- **1C31174G03** provides analog inputs 4 to 20mA, and analog outputs 4 to 20mA, digital inputs 24/48 VDC and digital outputs 60 VDC.
- **1C31174G04** provides analog inputs 4 to 20mA, and no analog output (Electric Drive), digital inputs 24/48 VDC and digital outputs 60 VDC.

18.2.3 PERSONALITY MODULES (PMODS)

There are three groups of Personality modules for the Loop Interface Module:

- **1C31177G01** provides voltage analog inputs and configurable remote or local shield grounding.
- **1C31177G02** provides current analog inputs and locally powered, local shield grounding.
- **1C31177G03** provides current analog inputs and field powered, remote shield grounding.

18.2.4 SUBSYSTEMS, LOOP INTERFACE

Loop Interface Subsystems[1]

RANGE	CHANNELS	ELECTRONIC MODULE	PERSONALITY MODULE
Normal (Non-electric) Drive Modules			
0-10V Analog Inputs/Output	6	1C31174G01	1C31177G01
0-10V AI/AO - user defined Digital Inputs[2]	6	1C31174G21	1C31177G01
0-5V Analog Inputs, 0-10V Analog Output	6	1C31174G02	1C31177G01
0-5V AI, 0-10V AO - user defined Digital Inputs[2]	6	1C31174G22	1C31177G01
4-20mA AI/AO Locally powered analog inputs	6	1C31174G03	1C31177G02
4-20mA AI/AO Field powered analog inputs	6	1C31174G03	1C31177G03
4-20mA AI/AO - user defined Digital Inputs[2] Locally powered analog inputs	6	1C31174G23	1C31177G02
4-20mA AI/AO - user defined Digital Inputs[2] Field powered analog inputs	6	1C31174G23	1C31177G03

When defining points for a normal (non-electric) drive Loop Interface module, the following point types are required for each channel:

I/O CHNL	NAME	TYPE	INPUT SOURCE OR OUTPUT DESTINATION	TERMINAL BLOCK CONNECTION
1	Raise Runback or user-defined [2]	Input	Loop Interface Module	DI1
2	Lower Runback or user-defined [2]	Input	Loop Interface Module	DI2
3	User Defined	Output	Loop Interface Module	DO1
4	User Defined	Output	Loop Interface Module	DO2
5	Process Variable Input (dedicated)	Input	Loop Interface Module	AI1
6	Setpoint Input (optional)	Input	Loop Interface Module	AI2
None	Output	Output	Loop Interface Module	AI3
Two additional channels are used at Emod Revision 5 or higher:				
6	Controller Process Variable	Output	Analog	No Terminations
7	Controller Set Point	Output	Analog	No Terminations

Electric Drive Modules			
4-20mA Inputs; No Output Locally powered analog inputs	4	1C31174G04	1C31177G02
4-20mA Inputs; No Output Field powered analog inputs	4	1C31174G04	1C31177G03
4-20mA Inputs; No Output - user defined Digital Inputs[2] Locally powered analog inputs	4	1C31174G24	1C31177G02
4-20mA Inputs; No Output - user defined Digital Inputs[2] Field powered analog inputs	4	1C31174G24	1C31177G03

RANGE	CHANNELS	ELECTRONIC MODULE	PERSONALITY MODULE

When defining points for an electric drive Loop Interface module, the following point types are required for each channel:

I/O CHNL	NAME	TYPE	INPUT SOURCE OR OUTPUT DESTINATION	TERMINAL BLOCK CONNECTION
1	Raise Runback or user-defined [2]	Input	Loop Interface Module	DI1
2	Lower Runback or user-defined [2]	Input	Loop Interface Module	DI2
None	Output Raise Pulse (dedicated)	Output	Loop Interface Module	DO1
None	Output Lower Pulse (dedicated)	Output	Loop Interface Module	DO2
5	Process Variable Input (dedicated)	Input	Loop Interface Module	AI1
6	Process Position (dedicated)	Input	Loop Interface Module	AI2
None	Output	Output	Output is compared to Process Position. Raise/Lower pulses (DO1, DO2) are generated as applicable.	No Terminations
Two additional channels are used at Emod Revision 5 or higher:				
7	Controller Process Variable	Output	Analog	No Terminations
8	Controller Set Point	Output	Analog	No Terminations

[1] This module will control **ONE** process loop. To use this module, the MASTATION algorithm must reside in the Ovation Controller. (See the *Ovation Algorithm Reference Manual.)*

[2] Raise and Lower Runback inputs can be disabled and used as user-defined input points. Configuration instructions are included in Kit 1C31174G20.

[3] This output may not appear on the termination list, but must be terminated for proper operation.

All Configurations are CE Mark Certified

18.3 MODULE SPECIFIC INFORMATION

18.3.1 MODES OF OPERATION

There are four modes of operation for the Loop Interface module:

- Cascade
- Auto
- Manual (also supports Timed-out Manual sub-mode)
- Local (also supports Timed-out Local sub-mode)

Operation Modes

MODE	SOURCE FOR OUTPUT (DEMAND)	SOURCE FOR SETPOINT
Cascade	Controller	Controller
Auto	Controller	Controller or SLIM
Manual	Controller or SLIM	Controller or SLIM
Local [1]	SLIM	SLIM
[1] When in Local mode, the Loop Interface module accepts mode change requests from the SLIM only.		

Runbacks

For the Ovation Loop Interface module, the digital inputs perform the runback function. The digital inputs are used as priority raise or lower for the output. Priority action takes precedence over any output request from the Controller or SLIM. Runbacks may be used with either of the two module types (Normal (non-electric) or Electric Drive).

If desired, digital inputs as runbacks can be disabled and used as user-defined digital input points. In order to disable digital inputs as runback functions, the module must be configured per instructions on drawing 1C31174 (Groups 21-24).

18.3.2 MANUAL STATION CONTROL

The single-loop interface module may communicate to the Small Loop Interface Module (SLIM) via its RS-422 serial port. The serial port connector is located on the personality module. Alternatively, the serial port wiring may be connected directly at the terminal block.

A single SLIM will communicate with one Loop Interface module. Multiple Loop Interface modules per single SLIM are not supported. SLIMs are not required for the loop interface module operation. (The loop interface module may be used without a SLIM.)

18.3.3 NORMAL AND INVERSE ANALOG OUTPUT

A wire jumper between terminals IAO and logic GND can be used to set the analog output to Inverse Operation.

Normal (default - no wire installed) operation of the analog output means that when the output value is 0% (as seen at the SLIM or Controller), the analog output is a minimum (0V for groups 1 and 2, or 4mA for groups 3 and 4 modules). When the output value is 100%, the actual analog output is at its maximum value (+10V for group 1, +5V for group 2, and 20mA for groups 3 and 4 modules).

Inverse (wire jumper installed) operation of the analog output means that when the output value is 0% (as seen at the SLIM or Controller), the analog output is a maximum (+10V for group 1, +5V for group 2, and 20mA for groups 3 and 4 modules). When the output value is 100%, the analog output is its minimum value (0V for groups 1 and 2, or 4mA for groups 3 and 4 modules).

18.3.4 EXTERNAL POWER SUPPLIES

If the Loop Interface subsystem uses the 1C31177G02 Personality module (configured for two 4 to 20 mA current analog inputs that are locally powered), the required voltage supply may be obtained from the internal Ovation auxiliary power supply (available through the terminal block), or it may be obtained from an external power supply.

If an external power supply is used, Using an External Power Supply (see page 539) contains steps to be undertaken before connecting the external power supply to the Loop Interface module base unit terminal block. The Loop Interface module auxiliary supply voltage level (24 VDC or 48 VDC) depends on the external transmitter devices being interfaced to the Loop Interface module's analog inputs.

18.4 WIRING INFORMATION

18.4.1 LOOP INTERFACE TERMINAL BLOCK WIRING INFORMATION

Each Personality module has a simplified wiring diagram label on its side, which appears above the terminal block. This diagram indicates how the wiring from the field is to be connected to the terminal block in the base unit.

The diagrams for the loop interface Personality modules are illustrated in below. The following table lists and defines the abbreviations used in those diagrams.

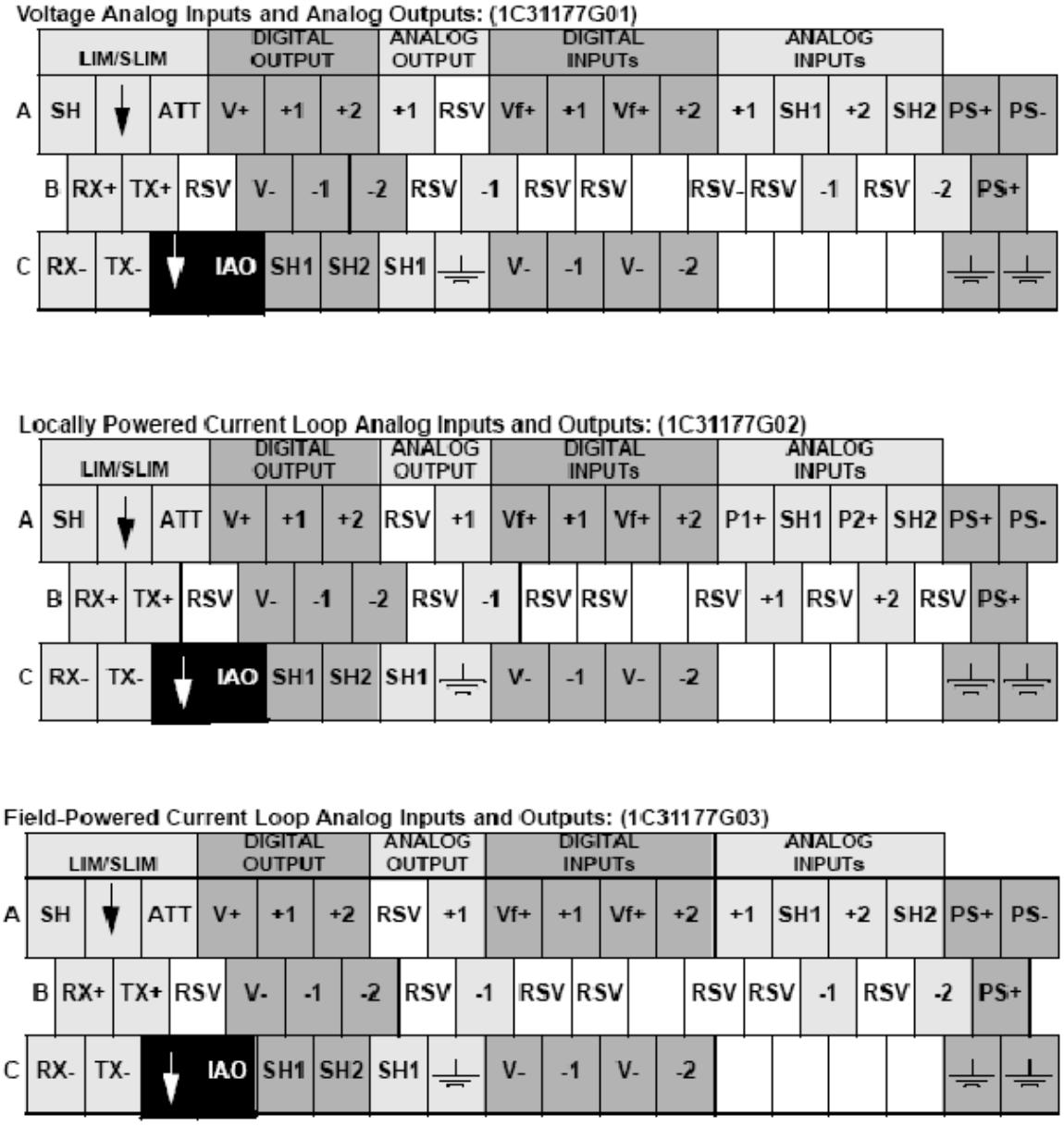
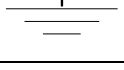

Voltage Analog Inputs and Analog Outputs: (1C31177G01)
LIM/SLIM
DIGITAL OUTPUT
ANALOG OUTPUT
DIGITAL INPUTs
ANALOG INPUTs
A SH ATT V+ +1 +2 +1 RSV Vf+ +1 Vf+ +2 +1 SH1 +2 SH2 PS+ PS-
B RX+ TX+ RSV V- -1 -2 RSV -1 RSV RSV RSV- RSV -1 RSV -2 PS+
C RX- TX- IAO SH1 SH2 SH1 V- -1 V- -2
Locally Powered Current Loop Analog Inputs and Outputs: (1C31177G02)
LIM/SLIM
DIGITAL OUTPUT
ANALOG OUTPUT
DIGITAL INPUTs
ANALOG INPUTs
A SH ATT V+ +1 +2 RSV +1 Vf+ +1 Vf+ +2 P1+ SH1 P2+ SH2 PS+ PS-
B RX+ TX+ RSV V- -1 -2 RSV -1 RSV RSV RSV +1 RSV +2 RSV PS+
C RX- TX- IAO SH1 SH2 SH1 V- -1 V- -2
Field-Powered Current Loop Analog Inputs and Outputs: (1C31177G03)
LIM/SLIM
DIGITAL OUTPUT
ANALOG OUTPUT
DIGITAL INPUTs
ANALOG INPUTs
A SH ATT V+ +1 +2 RSV +1 Vf+ +1 Vf+ +2 +1 SH1 +2 SH2 PS+ PS-
B RX+ TX+ RSV V- -1 -2 RSV -1 RSV RSV RSV RSV -1 RSV -2 PS+
C RX- TX- IAO SH1 SH2 SH1 V- -1 V- -2

Figure 88: Terminal Block Connections for the Loop Interface Personality Modules

Loop Interface Terminal Block Wiring Information

SECTION	ABBREVIATION	DEFINITION
LIM/SLIM (see page 407) [1]	SH [2]	Shield terminal connection
		Logic ground
	ATT	Attention
	RX ±	Receive data
	TX ±	Transmit data
DIGITAL OUTPUT	V ±	Voltage source terminal connection
	± 1, ± 2	Positive or negative terminal connection
	SH1, SH2 [2]	Shield terminal connection
ANALOG OUTPUT [3]	± 1	Positive or negative terminal connection
	SH1 [2]	Shield terminal connection
		Earth ground terminals
	IAO	When connected to logic ground, results in an inverse analog output (see page 242) operation.
DIGITAL INPUTS [4]	± 1, ± 2	Positive or negative terminal connection
	V-	Fused voltage source terminal ground connection
	Vf+	Fused voltage source terminal connection
ANALOG INPUTS [5]	± 1, ± 2	Positive or negative terminal connection
	SH1, SH2 [2]	Shield terminal connection
	P1+, P2+	Positive terminal connection for current loop power
PS ±	PS ±	Auxiliary power supply terminals
Earth GND		Earth ground terminals
RSV	RSV	Reserved. No connections allowed on these terminals.

SECTION	ABBREVIATION	DEFINITION
[1] No connections to terminals are required when using a SLIM cable (5A26166) connected to a Loop Interface Personality module in non-CE Mark certified systems. In CE Mark systems, SLIM cable 5A26429 MUST be used and grounded at the entry point of the cabinet using the recommended hardware (refer to the appropriate “Cable Guidelines” information for your system). [2] Non-CE Mark certified systems only. [3] For Group 3 current Loop Interface modules, analog output **MUST** be connected for proper operation, or an analog output error will be reported. [4] If digital inputs as runbacks are not desired (but are enabled), a shorting wire **MUST** be placed across inputs (+1 to -1 and +2 to -2) to eliminate false turn on from noise. [5] For Group 3 and 4 current Loop Interface modules, analog inputs **MUST** be connected for proper operation, or an analog input error will be reported.		

Note: *Do **not** use unmarked terminal block locations or locations marked RSV.*
*Shield terminals (SH) are **not** connected in CE Mark systems.*
The analog output is not present on Electric Drive modules.

18.4.2 Loop Interface Field Connection Wiring Diagrams

Non-CE Mark Certified Systems

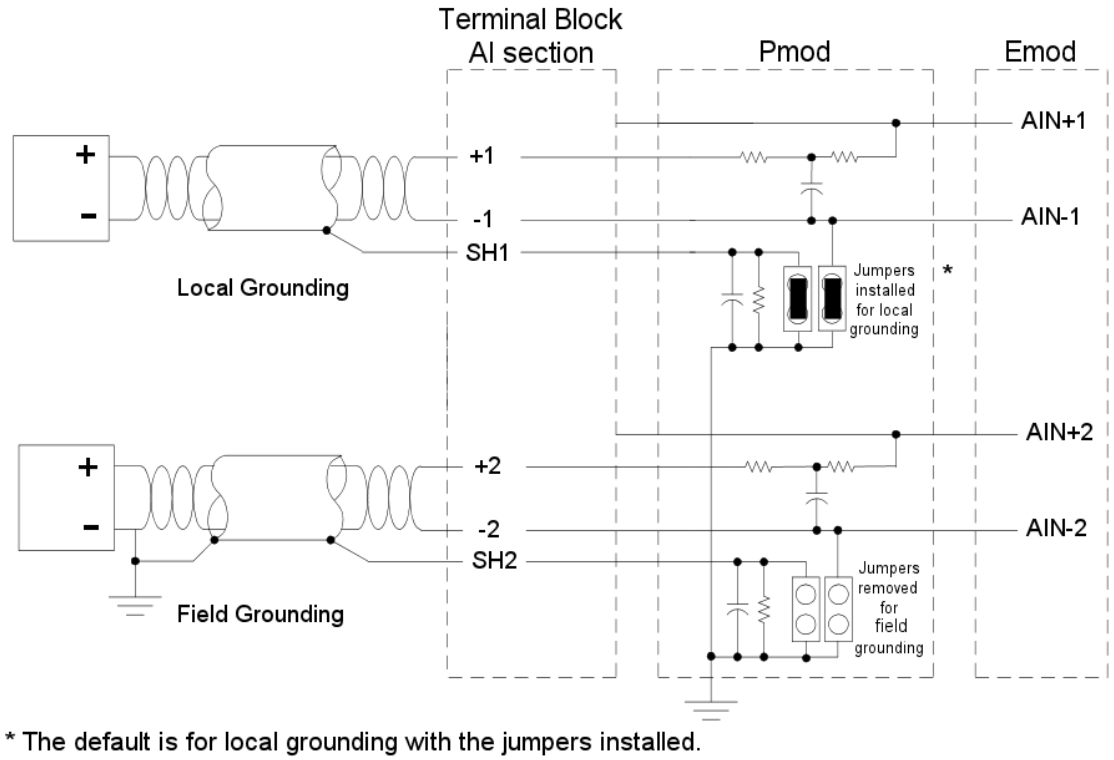
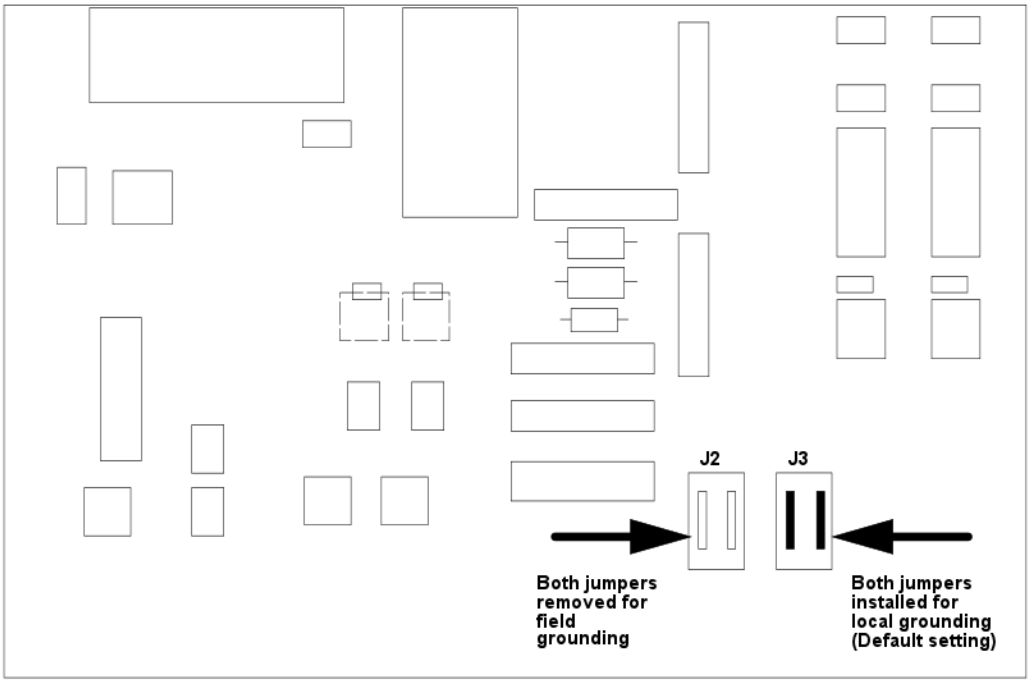


Figure 89: Voltage Analog Input Field Connections (Non-CE Mark)



Note

Circuit board must be removed from Personality module housing to access jumpers.

Figure 90: Jumper Settings for Voltage Analog Input Personality Module

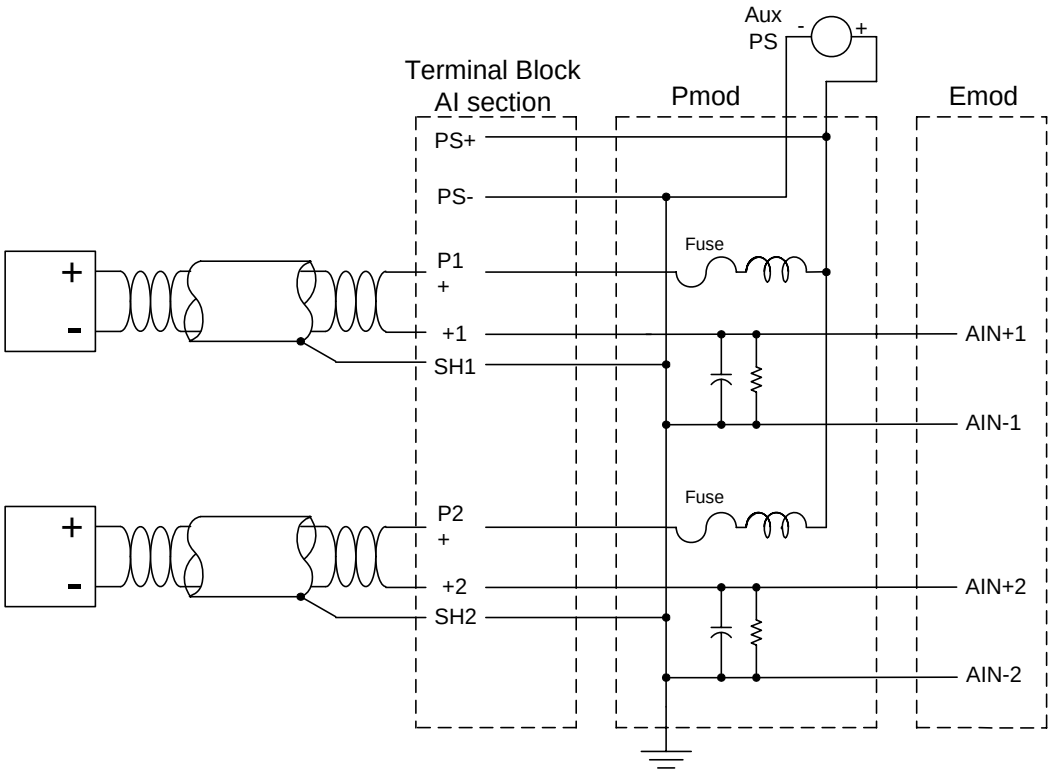


Figure 91: Locally Powered Current Analog Input Field Connections (Non-CE Mark)

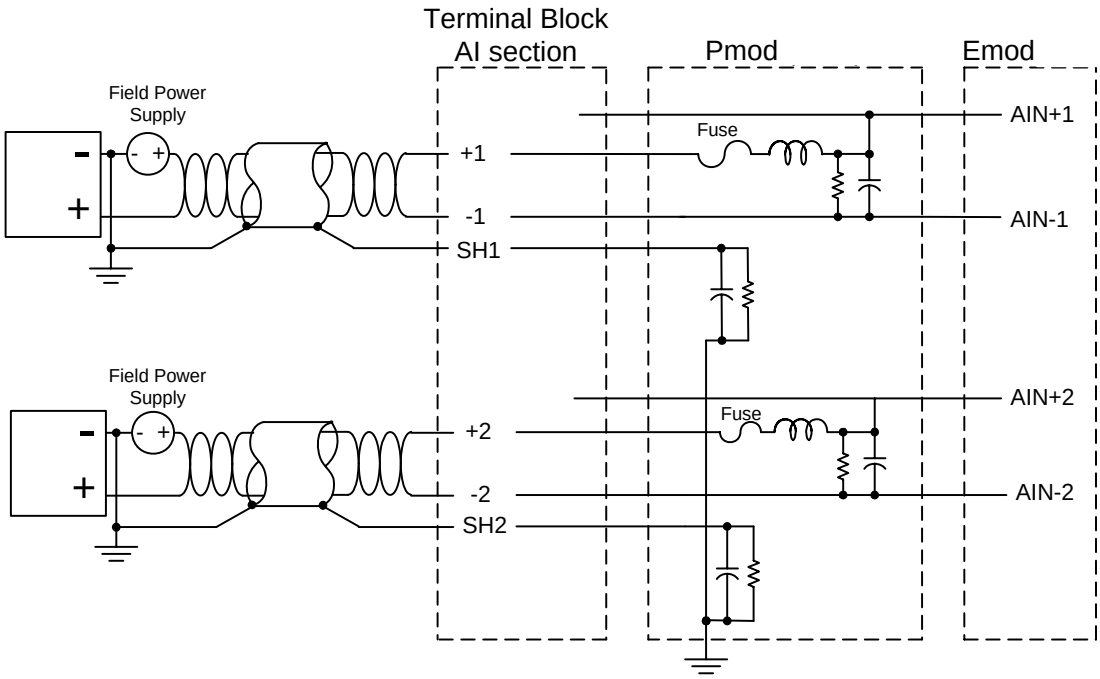
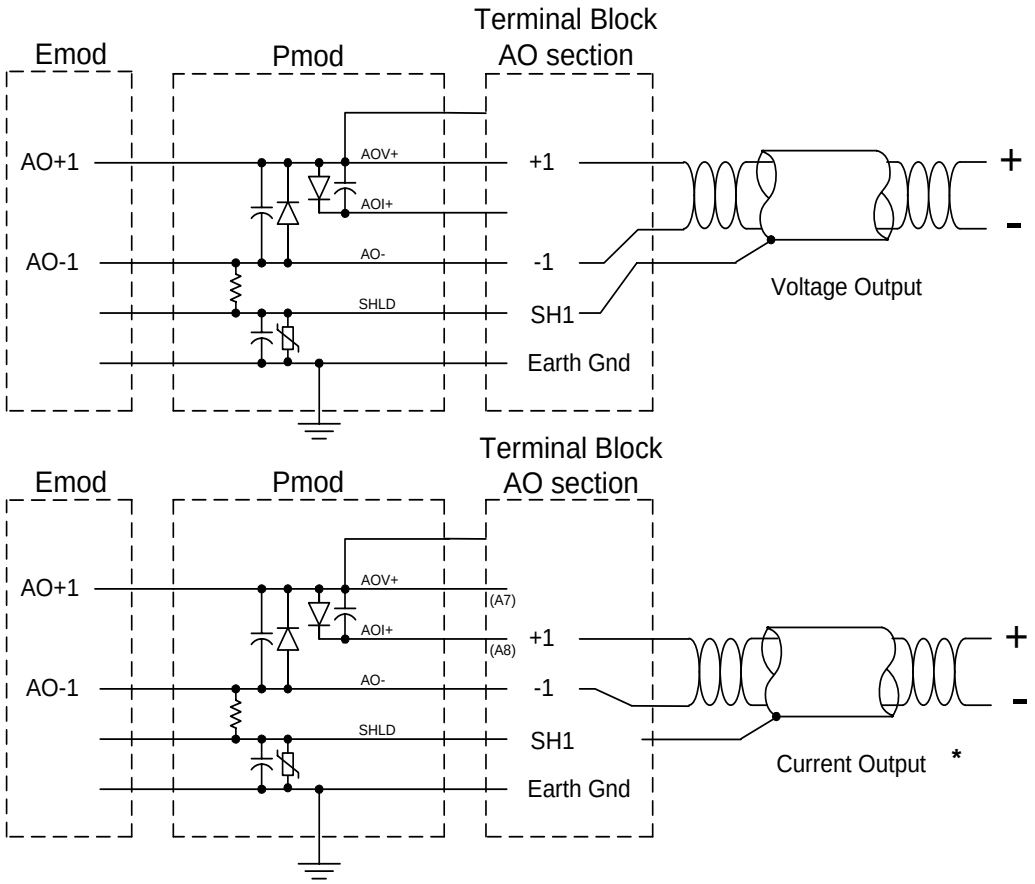


Figure 92: Field Powered Current Analog Input Field Connections (Non-CE Mark)



* Connect meter between AOV+ and AOI+ (A7 and A8) to measure current without disconnecting loop.

Figure 93: Analog Output Field Connections (Non-CE Mark)

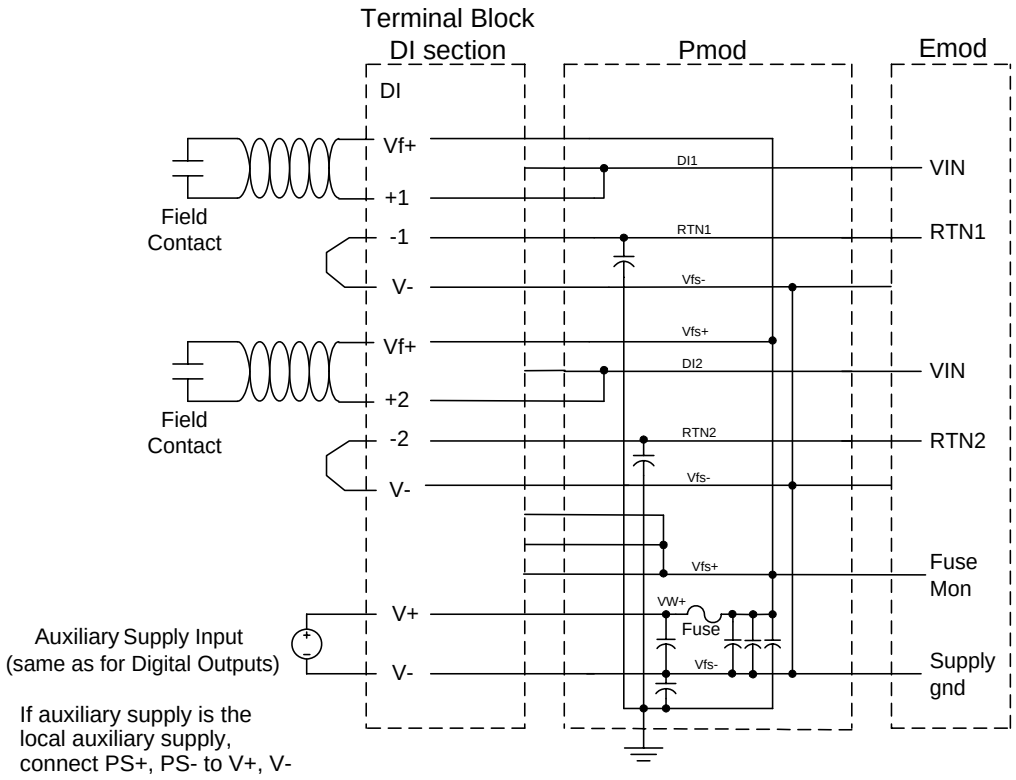


Figure 94: Digital Inputs (local auxiliary supply) Field Connections (Non-CE Mark)

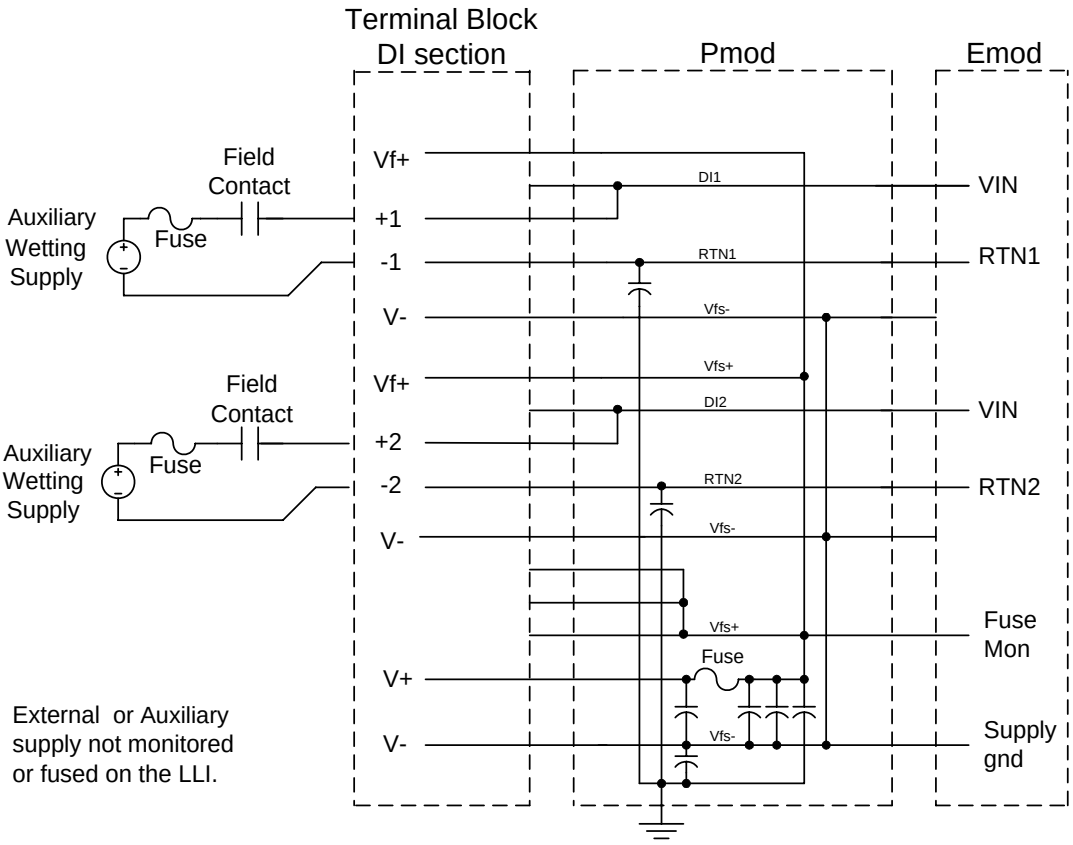


Figure 95: Digital Inputs (field auxiliary supply) Field Connections (Non-CE Mark)

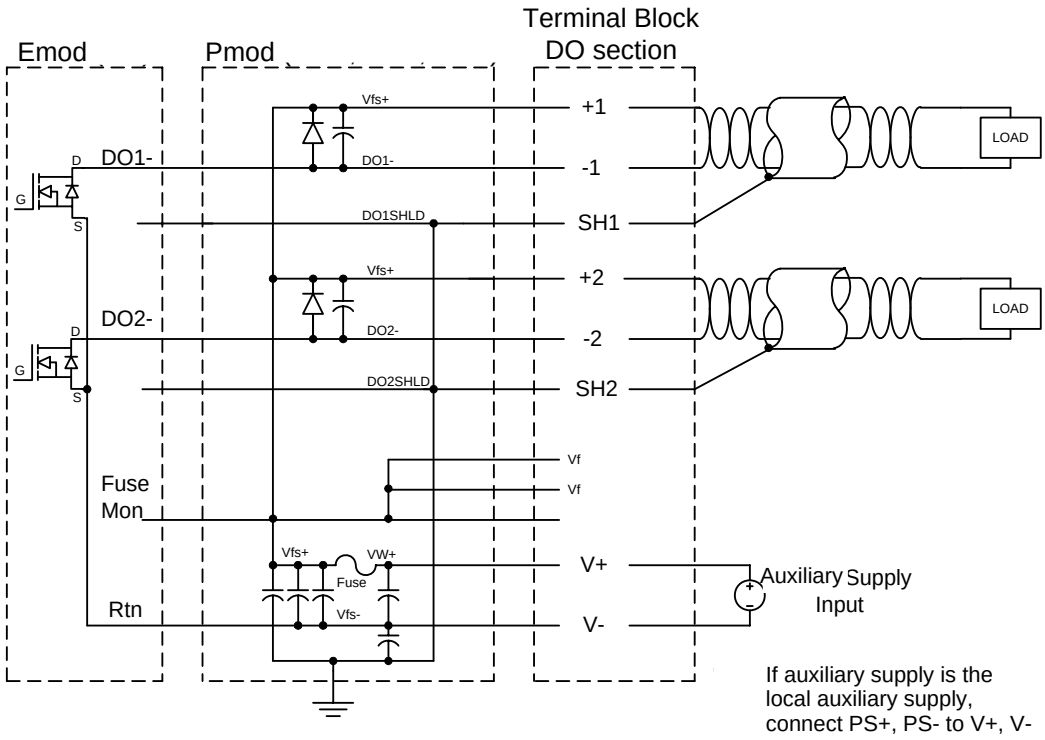


Figure 96: Digital Outputs (local aux supply) Field Connections (Non-CE Mark)

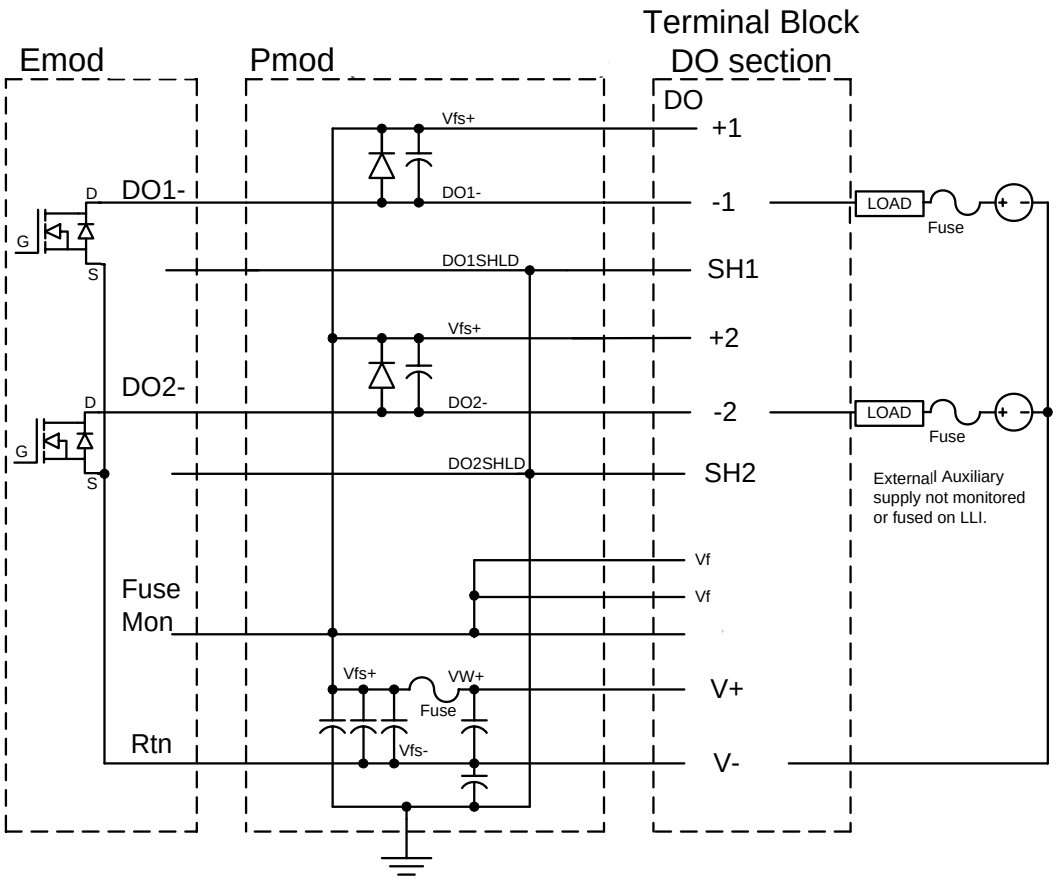
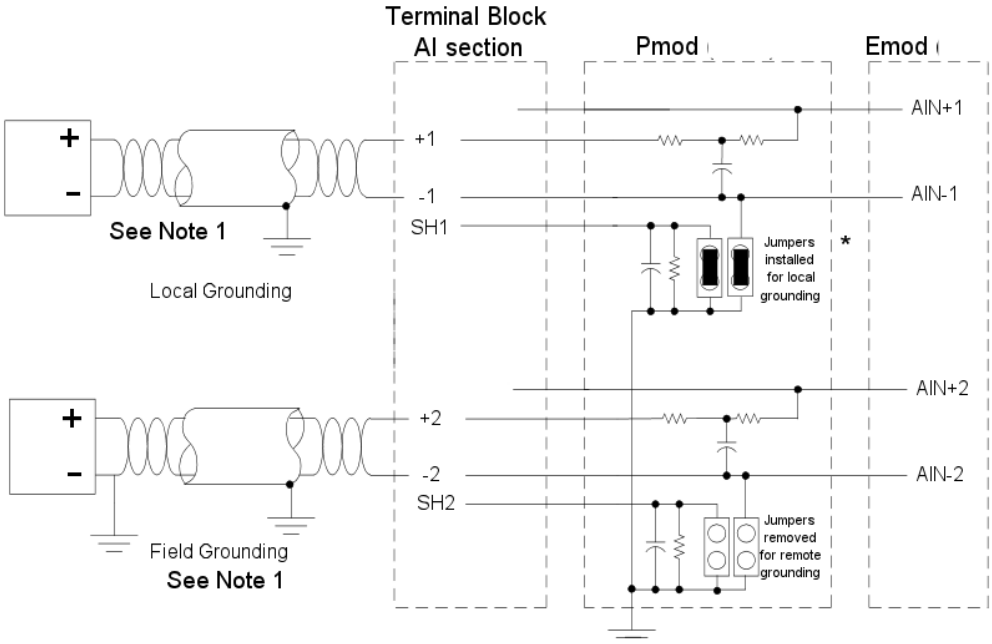


Figure 97: Digital Outputs (field aux supply) Field Connections (Non-CE Mark)

CE Mark Certified Systems

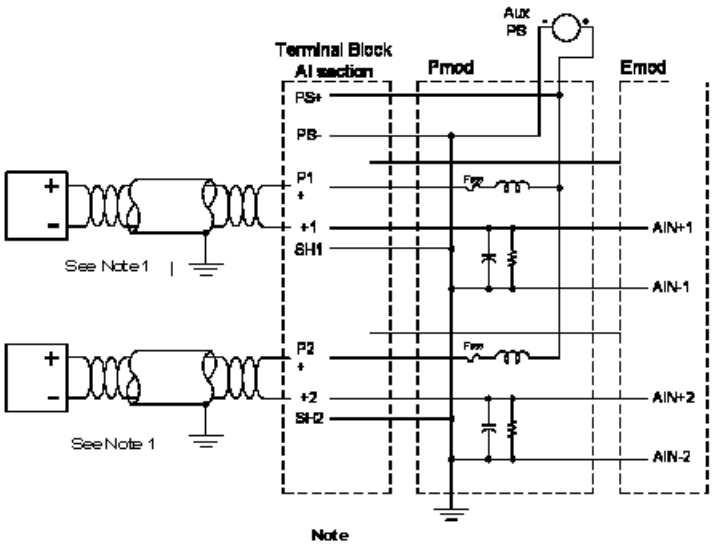


* The default is for local grounding with the jumpers installed.

Note

1. All field wiring must be braid-shielded and grounded at the entry point of the cabinet using the recommended hardware (refer to Cable Guidelines in the applicable *Planning Your Ovation System.*)

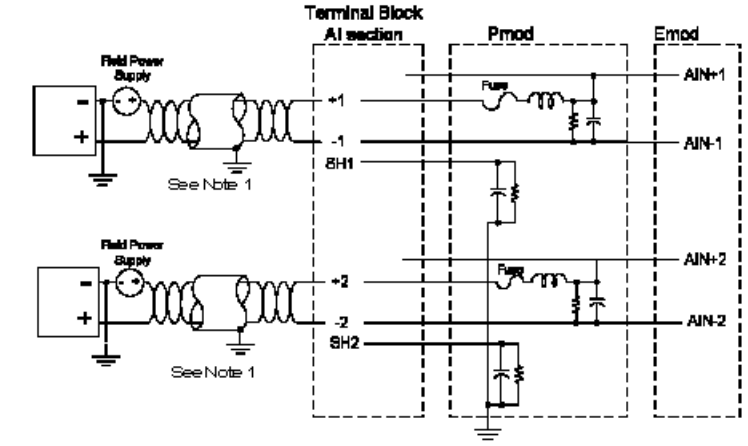
Figure 98: Voltage Analog Input Field Connections (CE Mark)



Note

1. All field wiring must be braid-shielded and grounded at the entry point of the cabinet using the recommended hardware

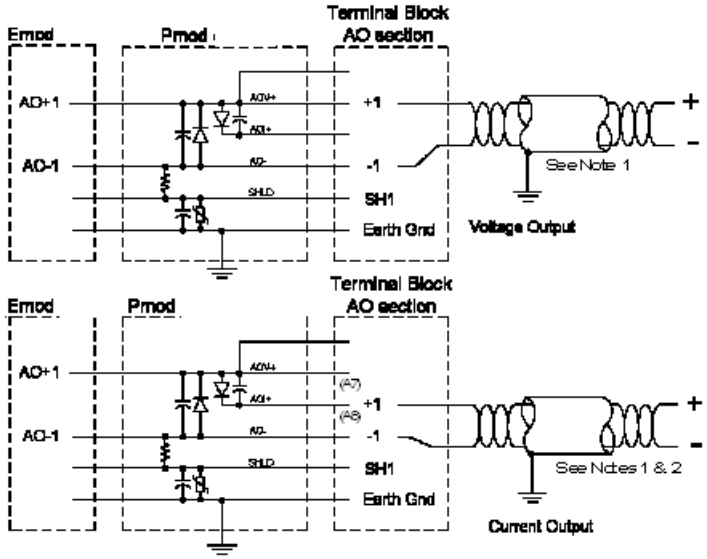
Figure 99: Locally Powered Current Analog Input Field Connections (CE Mark)



Note

1. All field wiring must be braid-shielded and grounded at the entry point of the cabinet using the recommended hardware

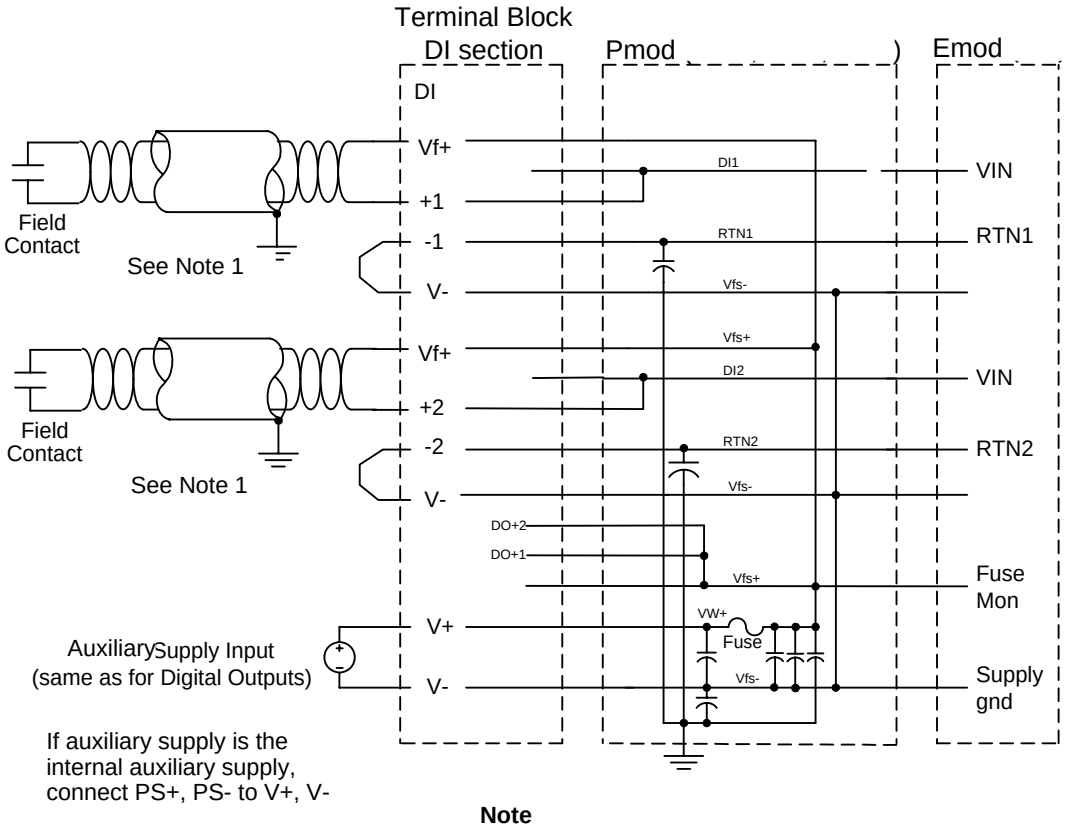
Figure 100: Field Powered Current Analog Input Field Connections (CE Mark)



Notes

1. All field wiring must be braid-shielded and grounded at the entry point of the cabinet using the recommended hardware (refer to Cable Guidelines in the applicable "*Planning YourOvation System*").
2. Connect meter between AOV+ and AOI+ (A7 and A8) to measure current without disconnecting loop.

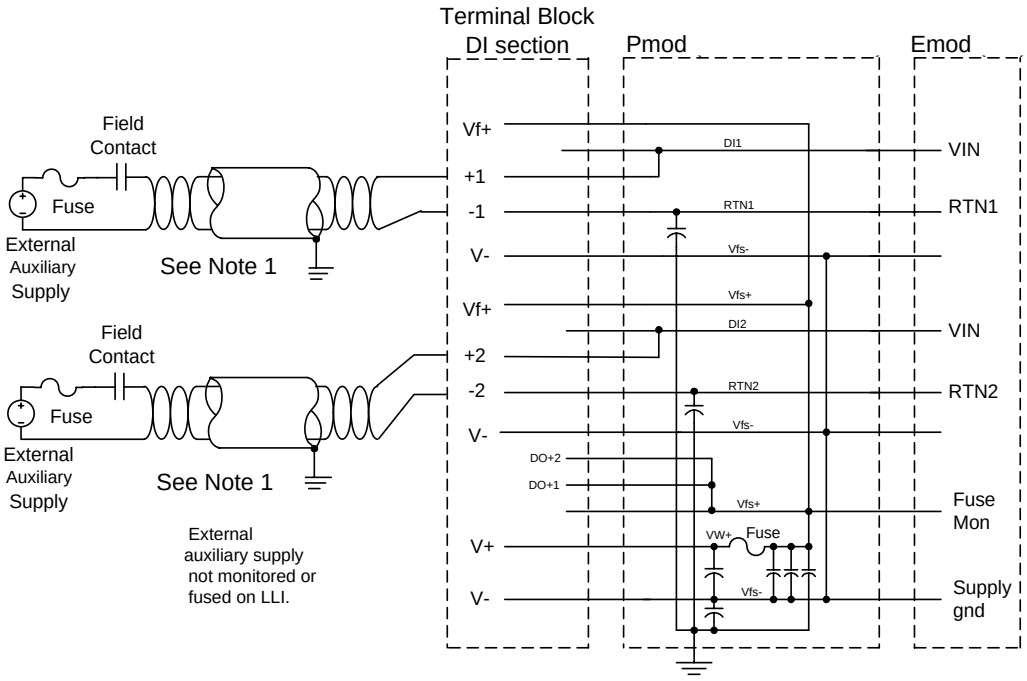
Figure 101: Analog Output Field Connections (CE Mark)



Note

1. All field wiring must be braid-shielded and grounded at the entry point of the cabinet using the recommended hardware (refer to Cable Guidelines in the applicable *Planning Your Ovation System*).

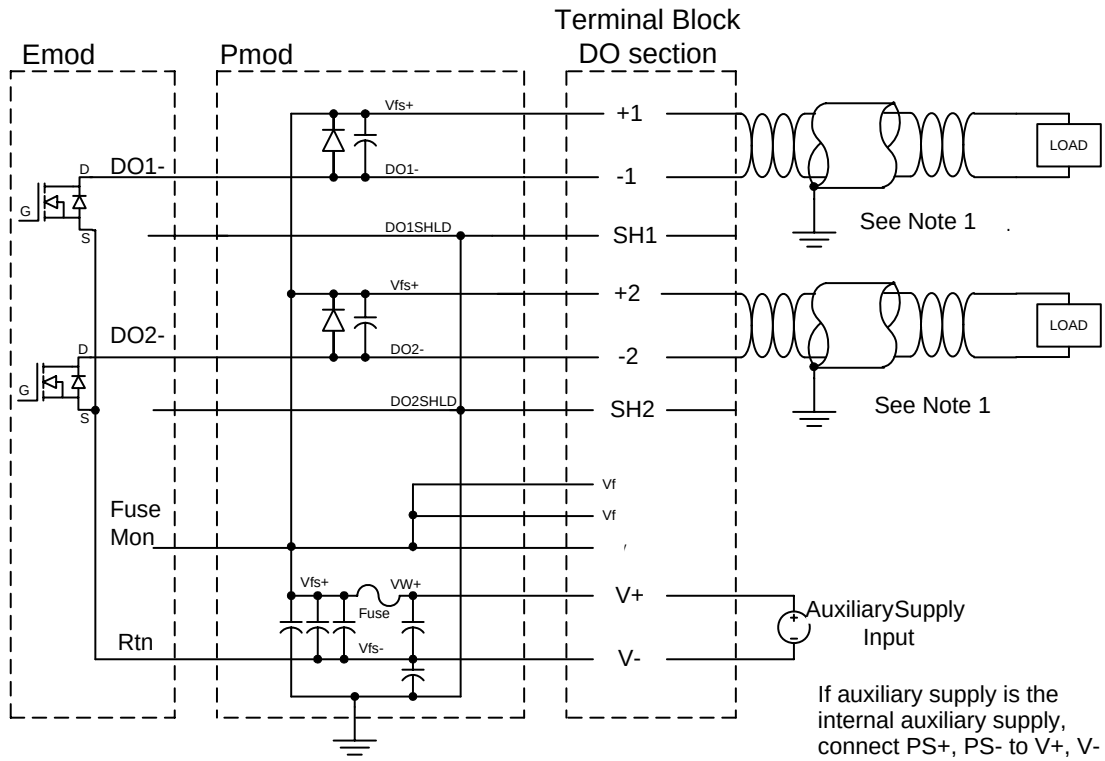
Figure 102: Digital Inputs (local auxiliary supply) Field Connections (CE Mark)



Note

1. All field wiring must be braid-shielded and grounded at the entry point of the cabinet using the recommended hardware (refer to Cable Guidelines in the applicable *Planning Your Ovation System*).

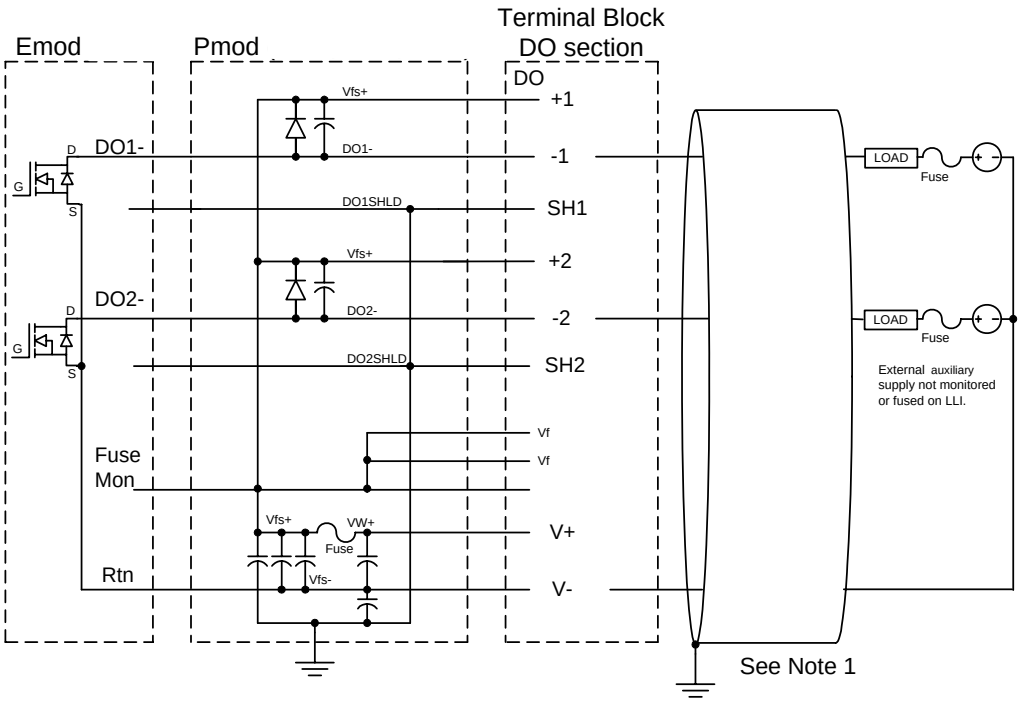
Figure 103: Digital Inputs (field auxiliary supply) Field Connections (CE Mark)



Note

1. All field wiring must be braid-shielded and grounded at the entry point of the cabinet using the recommended hardware (refer to Cable Guidelines in the applicable *"Planning Your Ovation System"*).

Figure 104: Digital Outputs (local auxiliary supply) Field Connections (CE Mark)



Note

1. All field wiring must be braid-shielded and grounded at the entry point of the cabinet using the recommended hardware (refer to Cable Guidelines in the applicable *Planning Your Ovation System*).

Figure 105: Digital Outputs (field auxiliary supply) Field Connections (CE Mark)

18.4.3 SLIM Serial Port Connector

The Personality module SLIM connector is used to connect the Loop Interface module to a SLIM module.

SLIM Connector (J1 RS-485) Pin Assignments

Pin Number	Signal Name (Function)	Signal Direction
1	SP-COMMON	NA
2	RX - (Receive Data)	Input
3	Shd (Cable Shield)	NA
4	RX+ (Receive Data)	Input
5	SLIM-ATT/(SLIM Cable Connector Attached) [1]	Input
6	TX+ (Transmit Data)	Output
7	No connection	NA
8	TX- (Transmit Data)	Output
9	SP-COMMON	NA

PIN NUMBER	SIGNAL NAME (FUNCTION)	SIGNAL DIRECTION

Front View of J1 Connector (Female DB 9)

1 SLIM cable 5A26166 is used to connect the SLIM to the Loop Interface Personality module in non-CE Mark systems. In CE Mark certified systems, SLIM cable 5A26429 must be used and grounded at the entry point of the cabinet (use recommended hardware described in Cable Guidelines in the applicable " *Planning Your Ovation System*").

18.5 ADDRESS LOCATION INFORMATION

18.5.1 CONFIGURATION AND STATUS REGISTER

Word address 13 (D in Hex) is used to configure the module and provide status information to the Controller. The status register can be read by using the Point Information window at an Operator Station (see the Bit Pattern field on the Hardware tab). (See the *Ovation Operator Station User Guide.)*

Loop Interface Configuration/Status Register (Address 13 or D in Hex)

BIT	DATA DESCRIPTION - CONFIGURATION REGISTER (WRITE)	DATA DESCRIPTION - STATUS REGISTER (READ)
0	Configure Module (1=configure)	Module is configured (1=configured; 0=unconfigured)
1	Force Error (1=error; 0=no error)	Internal or Forced Error (1=error; 0=no error)
2 - 4	Communications Timeout Setting	Communications Timeout Setting

BIT 4	BIT 3	BIT 2	TIMEOUT	BIT 4	BIT 3	BIT 2	TIMEOUT
0	0	0	16 seconds	0	0	0	16 seconds
0	0	1	4 seconds	0	0	1	4 seconds
0	1	0	2 seconds	0	1	0	2 seconds
0	1	1	1 seconds	0	1	1	1 seconds
1	0	0	500 milliseconds	1	0	0	500 milliseconds
1	0	1	250 milliseconds	1	0	1	250 milliseconds
1	1	0	125 milliseconds	1	1	0	125 milliseconds
1	1	1	62.5 milliseconds	1	1	1	62.5 milliseconds

5	For non-Electric Drive modules: 1 = Digital outputs hold state on Controller timeout 0 = Digital outputs shut off on Controller timeout.	For non-Electric Drive modules: 1 = Digital Outputs hold their state on Controller Timeout 0 = Digital Outputs are shut off on Controller timeout.
6	Not used	1 = LIM connector not attached
7	Not used	1 = LIM communications error
8	Not used	1 = Inverse Analog Output operation
9	Not used	1 = Digital inputs as runbacks disabled; 0 = Digital inputs as runbacks enabled
10	Not used	1 = Electric module (Beck) Drive
11	Not used	1 = EEPROM program enabled
12	Not used	Not used
13	1 = Enable blown fuse detection for digital input	1 = Blown fuse detection for Digital Inputs enabled.
14	1 = 50 Hz system, 0 = 60 Hz system	1 = 50 Hz system, 0 = 60 Hz system
15	Not used	1 = One of the bits in register C is set

18.5.2 SECONDARY CONFIGURATION AND STATUS REGISTER

Word address 14 (E in Hex) serves the purpose of the Secondary Configuration/Status Register.

Secondary Configuration/Status Register (Address 14 or E in Hex)

Bit	Data Description - Configuration Register (Write)	Data Description - Status Register (Read)
0	For Electric Drive Modules: 1 = Mode 2 Electric Drive 0 = Normal (Mode 1) Electric Drive	For Electric Drive Modules: 1 = Mode 2 Electric Drive 0 = Normal (Mode 1) Electric Drive
1	For Electric Drive Modules: 1 = Digital output pulses start with the ON time. 0 = Digital Output pulses start with the OFF time.	For Electric Drive Modules: 1 = Digital output pulses start with the ON time. 0 = Digital Output pulses start with the OFF time.
2	Enable blown fuse detection for digital outputs	Blown Fuse detection for Digital Outputs is enabled.
3 - 8	Not Used	Not Used
9*	1 = Controller defined setpoint 0 = Normal setpoint	1 = Controller defined setpoint enabled 0 = Normal setpoint

10*	1 = Controller defined process variable 0 = Normal PV operation	1 = Controller defined process variable enabled 0 = Normal process variable operation
11 - 15*	Not Used	Not Used
* Software supported only for Emods Rev 5 and higher.		

18.5.3 POINT QUALITY REGISTER

Word address 12 (C in Hex) serves the purpose of reporting the point quality.

Point Quality Register (Address 12 or C in Hex)

Bit	Write Definition	Read Definition
0	Not used	1 = Analog Input 1 auto calibration reasonability check failed
1	Not used	1 = Analog Input 1 over-range, blown fuse or open loop
2	Not used	1 = Analog Input 1 auto calibration reasonability check failed
3	Not used	1 = Analog Input 1 over-range, blown fuse or open loop
4	Not used	1 = Analog Input auxiliary supply blown fuse monitored and detected
5	Not used	1 = Analog Output over current
6	Not used	1 = Analog Output undercurrent
7	Not used	1 = Runback error (both raise and lower runbacks are active)
8 - 15	Not used	Internal (Initialization) Error Codes

18.6 DIAGNOSTIC LEDS

The following table lists the module's LEDs and describes what they mean when lit.

Loop Interface Diagnostic LEDs

LED	DESCRIPTION
P (Green)	Power OK LED. Lit when the +5V power is OK.
C (Green)	Communications OK LED. Lit when the Controller is communicating with the module.

LED	DESCRIPTION
I (Red)	Internal Error LED. Lit whenever there is any type of error with the module. Possible causes are: ▪ I/O bus communications watchdog timeout. ▪ Forced error issued by the Controller. ▪ Initialization error (SRAM error, invalid group, and so forth). ▪ Microcontroller watchdog timer timeout or module reset.
1 AO (Red)	Analog Output Error. Lit whenever there is an over current or undercurrent condition on the analog output section (Group 3 and 4 only).
2 AI1, 3 AI2 (Red)	Analog Input Error. Lit whenever there is an input error. Possible causes are: ▪ Input voltage over-range for 10 seconds. ▪ Broken current loop input/blown fuse for module configured as current input. ▪ Offset calibration voltage out of range for five consecutive calibrations (40 seconds).
4 Fuse (Red)	Blown Fuse Error. Lit if the auxiliary supply voltage for either the digital inputs or digital outputs is not present and blown fuse detection is enabled for either the digital outputs or the digital inputs.
5 SLIM (Red)	SLIM Communication Error. Lit if there is a SLIM serial port communications error.
6 DO1 (Green)	Digital Output Status. Lit when digital output 1 is active.
7 DO2 (Green)	Digital Output Status. Lit when digital output 2 is active.
8 DI1 (Green)	Digital Input Status. Lit when digital input 1 is active.
9 DI2 (Green)	Digital Input Status. Lit when digital input 2 is active.

18.7 SPECIFICATIONS

Electronics Module (1C31174)

Personality Module (1C31177)

The following tables provide specifications for the Loop Interface module:

- General Specifications
- Analog input
- Analog output
- Digital input
- Digital output).

Loop Interface General Specifications

DESCRIPTION	VALUE
Module power	Main: 2.7 W typical; 3.5 W maximum Aux (when used): **Digital Inputs:** 0.13W (24V) typical 0.27 W (48V) typical **Digital Outputs:** (power-dependent on loads for 2 outputs @ 100mA each) 4.8 W (24V) typical 9.6 W (48V) typical **Analog Inputs:** (2 inputs @ 20mA each) 0.96 W (24V) typical
Operating temperature range	0 to 60°C (32°F to 140°F)
Storage temperature range	-40°C to 85°C (-40°F to 185°F)
Humidity (non-condensing)	0 to 95%

Loop Interface Analog Input Module Specifications

DESCRIPTION	VALUE
Number of analog input points	2
Input range	0 to +10 V (G01) 0 to +5 V (G02) 4 to 20 mA (G03 - G04) AI1 and AI2 current inputs must be terminated (even if not used) to prevent point fault generation.

DESCRIPTION	VALUE
Resolution	13 bits (including polarity)
Guaranteed accuracy (@25°C) [1]	±0.10% of upper range value ±10µV ±1/2LSB @99.7% confidence
Temperature coefficient	±0.24% of the upper range value ±24µV over 0 to 60°C.
Input impedance: 0 to 10V groups 0 to 5V groups, and 4 to 20mA groups	 2 MΩ 1 MΩ
Sampling rate	10 samples per second under normal conditions. 8 samples per second during auto calibration.
Offset and gain temperature drift compensation	Automatic
Diagnostics	Internal module operating faults. Out of range detection. Open loop/blown fuse detection for current loops.
Dielectric isolation: Channel to channel Channel to logic	 1000 V AC/DC 1000 V AC/DC
Normal mode rejection	60 dB at 50 Hz ± 1/2% or 60 Hz ± 1/2% 30 dB (typical) at 50 Hz ± 5% or 60 Hz ± 5%
Common mode rejection	120 dB at DC; power line frequency and its harmonics ± 1/2% without line frequency tracking. 100 dB (typical) for nominal line frequency ± 5% and harmonics without line frequency tracking.
[1] See additional information for CE Mark certified systems.	

Loop Interface Analog Output Module Specifications

DESCRIPTION	VALUE
Number of points	1 - Analog output is not present for Group 4 (electric drive) modules. AO current outputs in G03 - G04 must be terminated (even if not used) to prevent point fault generation.
Maximum update time	2 mSec
Output range	0 - 10 V@ minimum 1 kΩ load impedance (10mA maximum load) (G01 - G02) 4 - 20 mA @ maximum 750 Ω load impedance (0 Ω minimum) (G03)
Resolution	12 bits

DESCRIPTION	VALUE
Guaranteed accuracy (@25°C ± 1°C) [1]	±0.10% of span
Temperature coefficient	0 to 10 V groups: 30 ppm/°C 4 to 20mA groups: 45 ppm/°C
User loop voltage	Power for current loop output is supplied by module.
Diagnostics	Internal module operating faults ▪ Overcurrent ▪ Undercurrent
Dielectric isolation: Channel ground to channel ground Channel ground to logic ground	 Maximum ± 1000 V AC/DC Maximum ± 1000 V AC/DC
Output loading	0 - 10 V@ minimum 1 kΩ load impedance (10mA maximum load) 4 - 20 mA @ maximum 750 Ω load impedance (0 Ω minimum)
[1] See additional information for CE Mark certified systems (see page 537).	

Loop Interface Digital Input Module Specifications

DESCRIPTION	VALUE
Number of points	Two digital inputs dedicated as runback inputs. If runbacks are not desired, shorting wires should be placed across the inputs (+1 to -1 and +2 to -2) to eliminate possible false turn on from noise.
Input range	24V or 48V typ 18 -60 VDC
Propagation delay of contact change of state	1.9 mSec minimum; 35.0 mSec maximum
Cable length (quality is 50pF/ft or better)	1000 feet maximum
Diagnostics	Internal module operating faults ▪ Auxiliary power supply blown fuse detection (enabled/disabled) ▪ Runback error (both raise and lower active)
Dielectric isolation: Channel ground to channel ground Channel ground to logic ground	 Maximum 1000V AC/DC Maximum 1000V AC/DC
External (auxiliary) power supply	If desired, the digital input auxiliary supply voltage may be the same voltage as that used for the digital outputs. This voltage is provided as an output between terminals Vf+ and V-. This fused voltage (Vf+) is monitored as an additional digital input. Input characteristics are identical to the other two digital inputs.

Loop Interface Digital Output Module Specifications

DESCRIPTION	VALUE
Number of points	2
Output voltage	
Off voltage (maximum)	5 VDC minimum, 60 VDC maximum (auxiliary power supply)
On voltage (maximum)	1.0 VDC @ 500mA
Output current	
Off current (maximum)	25mA @ TA=25×C, VDS=60 VDC
	250mA @ TA=60×C, VDS=60 VDC
On current for individual output (maximum)	500 mA
On current for two outputs combined (maximum)	880 mA limited by fuse rating
External (auxiliary) supply voltage	Voltage = 5 VDC minimum, 60 VDC maximum The return line and auxiliary power supply voltage is common to both points but is galvanically isolated from logic ground. This auxiliary supply voltage originates from the terminal block (on inputs V+ and V-) and is fused on the personality module. The fused voltage is distributed back out to the terminal blocks as +1, +2 for the digital outputs and Vf+ for the digital inputs. Each digital output is diode clamped to this fused auxiliary supply voltage to prevent damage from inductive load surges. The fused auxiliary supply voltage is monitored as an additional digital input. Input characteristics are identical to the digital inputs.
Diagnostics	Internal module operation faults Auxiliary supply blown fuse detection (enabled/disabled)
Maximum propagation time	14.5 mSec for Rload=500W This time is comprised of the microprocessor firmware digital output update rate, which is once per loop, or approximately every 12 ms, plus the delay time for the output, which is 2.5 ms max at Rload = 500 W.
Dielectric isolation:	
Channel ground to logic ground	Maximum ±1000V AC/DC

SECTION 19

PULSE ACCUMULATOR MODULE

IN THIS SECTION

Description *269*
Module Group Information *269*
Wiring Information *271*
Address Location Information *281*
Diagnostic LEDs *285*
Specifications *286*

19.1 DESCRIPTION

The Pulse Accumulator Module accumulates pulses for two input channels and provides the information to the Controller. There are three possible configurations:

- Counting pulses over a defined period of time allows the module to measure the speed of the input pulses (frequency).
- Counting pulses until instructed to stop counting either by the Ovation Controller or by an external field control input.
- Measuring the time duration of a pulse.

The Pulse Accumulator Module is applicable for CE Mark Certified Systems.

Note: *I/O Module General Information (see page 15) contains environmental, installation, wiring, and fuse information for I/O modules.*

19.2 MODULE GROUP INFORMATION

19.2.1 ELECTRONICS MODULES (EMODS)

There are two groups of Electronics modules for the Pulse Accumulator Module:

- **1C31147G01** provides for pulse accumulation at one of three possible pulse input levels:
  - ☐ 24/48 V (CT+ and CT- inputs). May be referenced to either negative or positive field signal power supply common. Applicable for CE Mark.
  - ☐ 12 V medium speed (MC+ and HM- inputs). Not applicable for CE Mark.
  - ☐ 5 V medium speed (HC+ and HM-). Not applicable for CE Mark.
- **1C31147G02** provides for pulse accumulation at 5 V high speed (HC+ and HM-). Not applicable for CE Mark certified systems.

19.2.2 PERSONALITY MODULES (PMODS)

There are three groups of Personality modules for the Pulse Accumulator Module:

- **1C31150G01** accepts 24/48 V count and control inputs from dry contacts or from open-collector transistor drivers. The input signals are low-true and are referenced to the branch internal auxiliary power supply return (common negative).
- **1C31150G02** accepts 24/48 V count and control inputs from dry contacts. The input signals are high-true and are referenced to the branch internal auxiliary power supply positive rail (common positive).
- **1C31150G03** provides dedicated 24/48 V count and control field input power for just this Pulse Accumulator Electronics module. The field input power is obtained from an external DC power supply that is connected to two base unit terminal block terminals (DSA and DSB).

Pulse Accumulator Subsystem[1]

COUNT INPUT LEVEL	CONTROL (ENABLE AND SNAPSHOT) INPUT LEVEL	CHANNELS	ELECTRONIC MODULE	PERSONALITY MODULE
24/48 V Medium Speed	24/48 V Medium Speed			
	Local field pwr. common neg.	2	1C31147G01	1C31150G01
	Local field pwr. common pos.	2	1C31147G01	1C31150G02
	Ext. field pwr. common pos. or neg.	2	1C31147G01	1C31150G03
5/12 V Medium Speed	24/48 V Medium Speed			
	Local field pwr. common neg.	2	1C31147G01	1C31150G01
	Local field pwr. common pos.	2	1C31147G01	1C31150G02
	Ext. field pwr. common pos. or neg	2	1C31147G01	1C31150G03
5 V High Speed	24/48 V Medium Speed			
	Local field pwr. common neg.	2	1C31147G02	1C31150G01
	Local field pwr. common pos.	2	1C31147G02	1C31150G02
	Ext. field pwr. common pos. or neg	2	1C31147G02	1C31150G03

[1] To use this module, the algorithm RPACNT or RPAWIDTH must reside in the Ovation Controller. Refer to the appropriate Algorithm Reference Manual for your system for detailed information about the RPACNT and RPAWIDTH algorithms.

19.3 WIRING INFORMATION

19.3.1 PULSE ACCUMULATOR TERMINAL BLOCK WIRING INFORMATION

Each Personality module has a simplified wiring diagram label on its side, which appears above the terminal block. This diagram indicates how to connect the field wiring to the terminal block in the base unit.

***Note:** Do **not** use unmarked terminal block locations.*

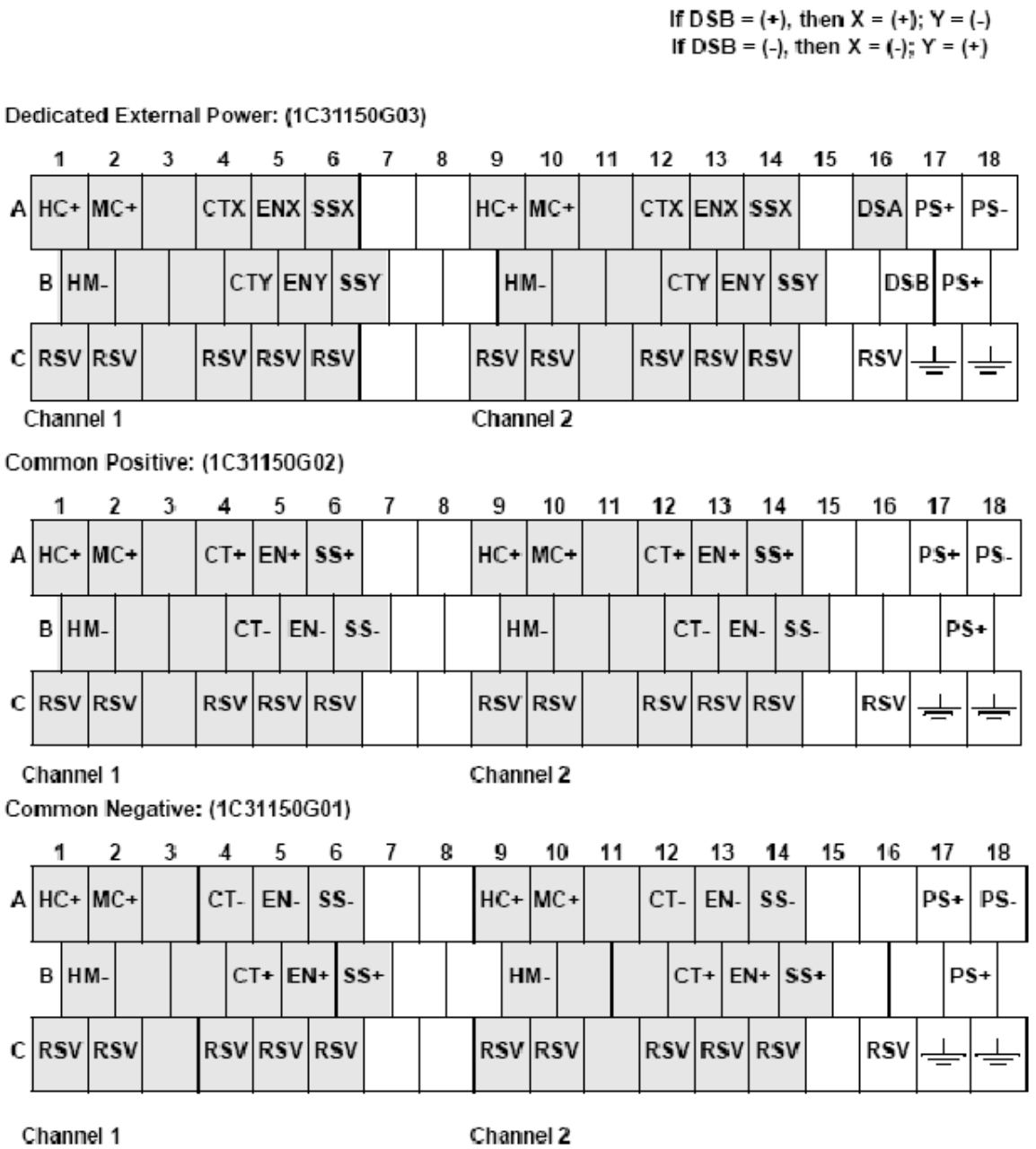
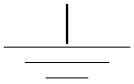

If DSB = (+), then X = (+); Y = (-)
If DSB = (-), then X = (-); Y = (+)
Dedicated External Power: (1C31150G03)
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18
A HC+ MC+ CTX ENX SSX HC+ MC+ CTX ENX SSX DSA PS+ PS-
B HM- CTY ENY SSY HM- CTY ENY SSY DSB PS+
C RSV RSV RSV RSV RSV RSV RSV RSV RSV RSV RSV RSV RSV RSV
Channel 1
Channel 2
Common Positive: (1C31150G02)
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18
A HC+ MC+ CT+ EN+ SS+ HC+ MC+ CT+ EN+ SS+ PS+ PS-
B HM- CT- EN- SS- HM- CT- EN- SS- PS+
C RSV RSV RSV RSV RSV RSV RSV RSV RSV RSV RSV RSV RSV RSV
Channel 1
Channel 2
Common Negative: (1C31150G01)
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18
A HC+ MC+ CT- EN- SS- HC+ MC+ CT- EN- SS- PS+ PS-
B HM- CT+ EN+ SS+ HM- CT+ EN+ SS+ PS+
C RSV RSV RSV RSV RSV RSV RSV RSV RSV RSV RSV RSV RSV RSV
Channel 1
Channel 2

Figure 106: Terminal Block Connections for the Pulse Accumulator Pmod

The following table lists and defines the diagram abbreviations.

Abbreviations Used in Diagrams

ABBREVIATION	DEFINITION
CTX	24/48V count terminal connection using external power
CTY	24/48V count terminal connection using external power
CT+	24/48V positive count terminal connection
CT-	24/48V negative count terminal connection
DSA	Dedicated external supply
DSB	Dedicated external supply
	Earth ground terminal
ENX	24/48V external enable connection using external power
ENY	24/48V external enable connection using external power
EN+	24/48V positive external enable connection
EN-	24/48V negative external enable connection
HC+	+5V high/medium speed count connection
HM-	5/12V high/medium speed count reference
MC+	+12V medium speed count connection
PS+, PS-	Auxiliary power supply terminals
RSV	Reserved terminal. No connections allowed on these terminals, except when specified for terminals C4 or C12.
SSX	24/48V snapshot connection using external power
SSY	24/48V snapshot connection using external power
SS+	24/48V positive snapshot connection
SS-	24/48V negative snapshot connection

19.3.2 PULSE ACCUMULATOR FIELD CONNECTION WIRING DIAGRAMS (NON-CE MARK CERTIFIED)

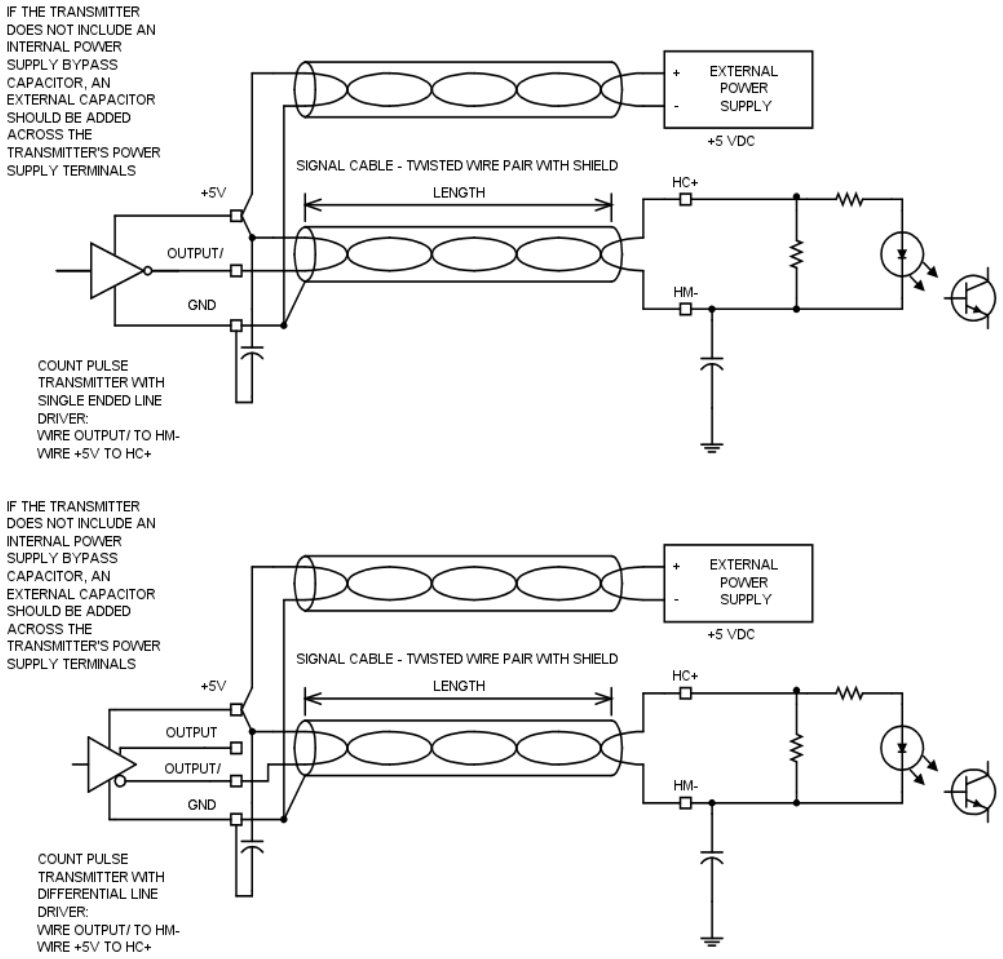

IF THE TRANSMITTER DOES NOT INCLUDE AN INTERNAL POWER SUPPLY BYPASS CAPACITOR, AN EXTERNAL CAPACITOR SHOULD BE ADDED ACROSS THE TRANSMITTER'S POWER SUPPLY TERMINALS
+ EXTERNAL POWER SUPPLY -
+5 VDC
SIGNAL CABLE - TWISTED WIRE PAIR WITH SHIELD
LENGTH
+5V
OUTPUT/
GND
HC+
HM-
COUNT PULSE TRANSMITTER WITH SINGLE ENDED LINE DRIVER:
WIRE OUTPUT/ TO HM-
WIRE +5V TO HC+
IF THE TRANSMITTER DOES NOT INCLUDE AN INTERNAL POWER SUPPLY BYPASS CAPACITOR, AN EXTERNAL CAPACITOR SHOULD BE ADDED ACROSS THE TRANSMITTER'S POWER SUPPLY TERMINALS
+ EXTERNAL POWER SUPPLY -
+5 VDC
SIGNAL CABLE - TWISTED WIRE PAIR WITH SHIELD
LENGTH
+5V
OUTPUT
OUTPUT/
GND
HC+
HM-
COUNT PULSE TRANSMITTER WITH DIFFERENTIAL LINE DRIVER:
WIRE OUTPUT/ TO HM-
WIRE +5V TO HC+

Figure 107: 5 V Count Field Connections - (Non-CE Mark)

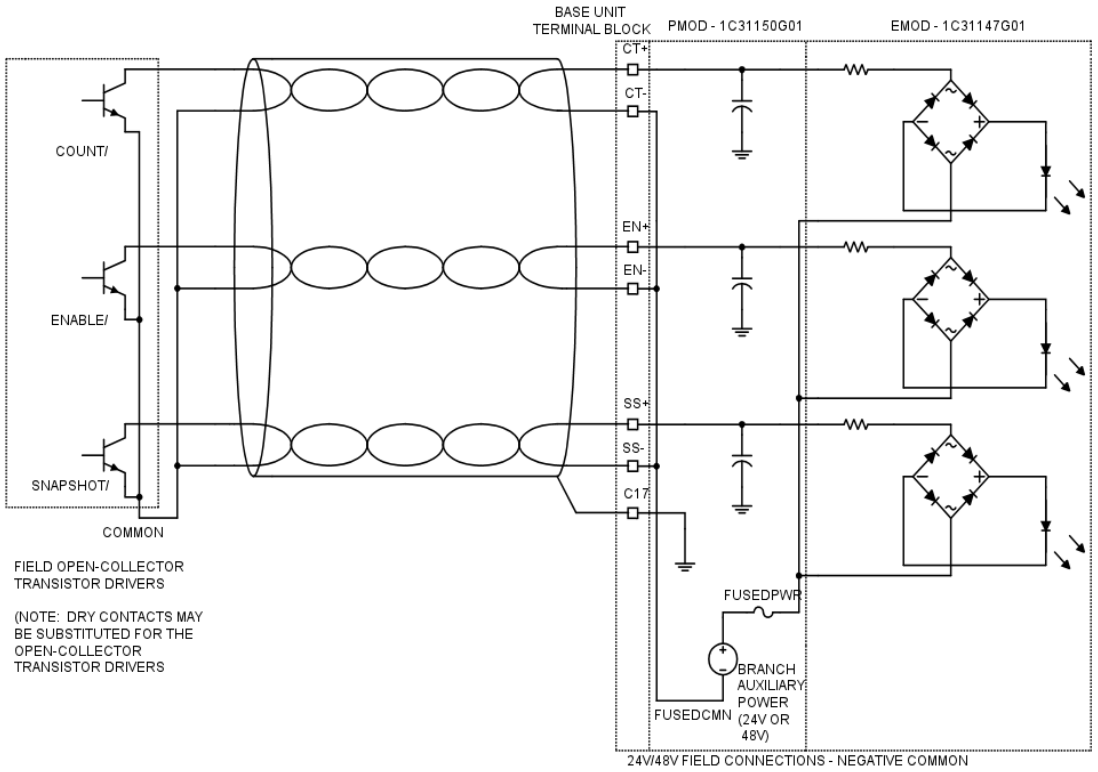


Figure 108: 24V/48V Field Connections - Common Negative (Non-CE Mark)

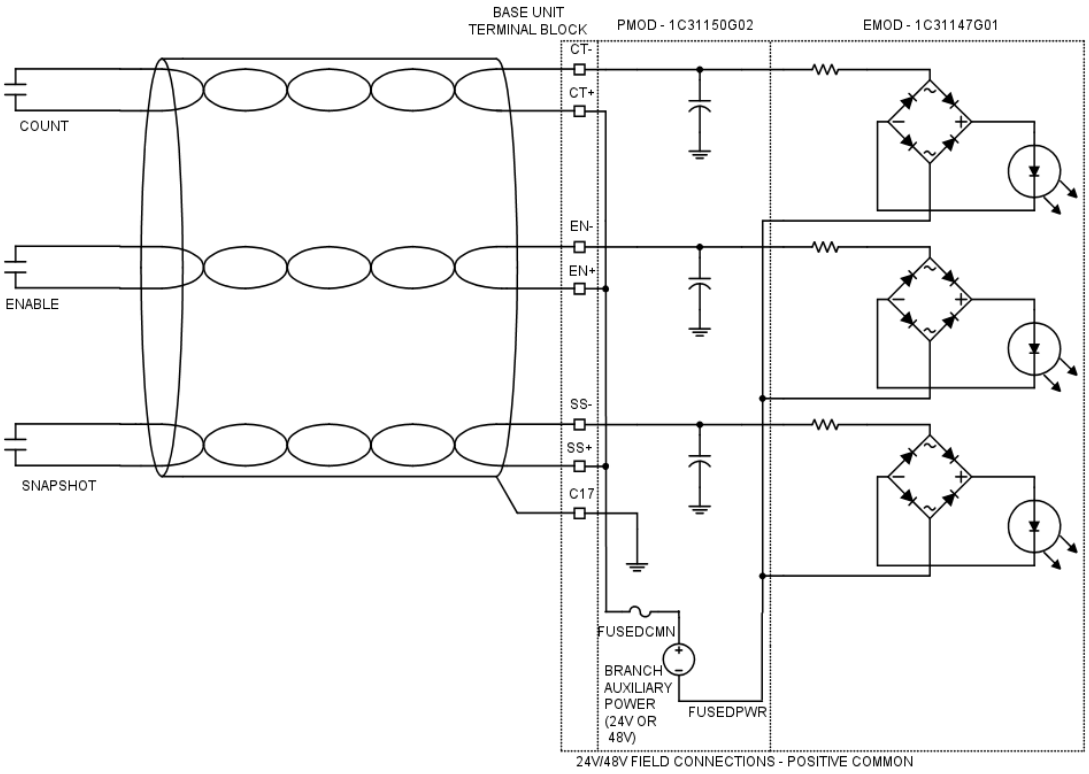


Figure 109: 24V/48V Field Connections - Common Positive (Non-CE Mark)

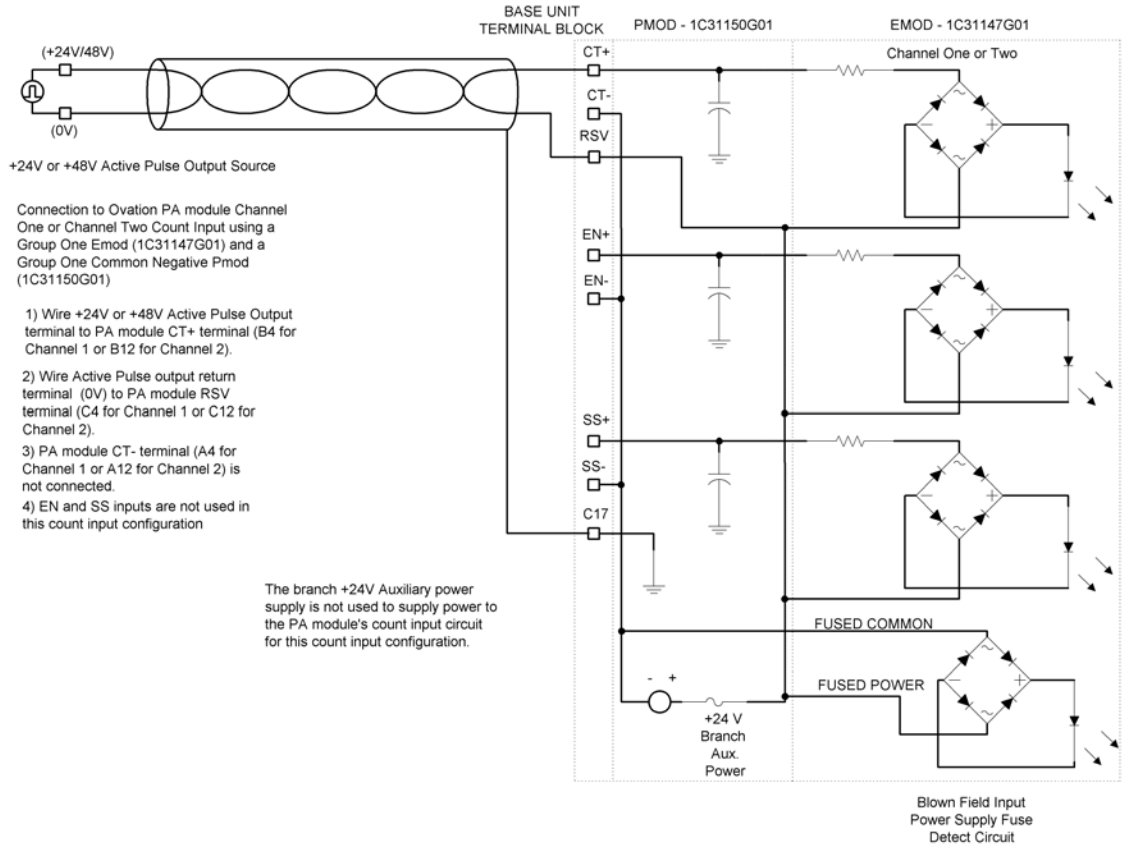

BASE UNIT
TERMINAL BLOCK
PMOD - 1C31150G01
EMOD - 1C31147G01
(+24V/48V)
(0V)
CT+
CT-
RSV
EN+
EN-
SS+
SS-
C17
Channel One or Two
+24V or +48V Active Pulse Output Source
Connection to Ovation PA module Channel One or Channel Two Count Input using a Group One Emod (1C31147G01) and a Group One Common Negative Pmod (1C31150G01)
1) Wire +24V or +48V Active Pulse Output terminal to PA module CT+ terminal (B4 for Channel 1 or B12 for Channel 2).
2) Wire Active Pulse output return terminal (0V) to PA module RSV terminal (C4 for Channel 1 or C12 for Channel 2).
3) PA module CT- terminal (A4 for Channel 1 or A12 for Channel 2) is not connected.
4) EN and SS inputs are not used in this count input configuration
The branch +24V Auxiliary power supply is not used to supply power to the PA module's count input circuit for this count input configuration.
FUSED COMMON
FUSED POWER
- +
+24 V
Branch
Aux.
Power
Blown Field Input
Power Supply Fuse
Detect Circuit

Figure 110: 24V/48V Active Pulse Source Count Connections - Common Negative

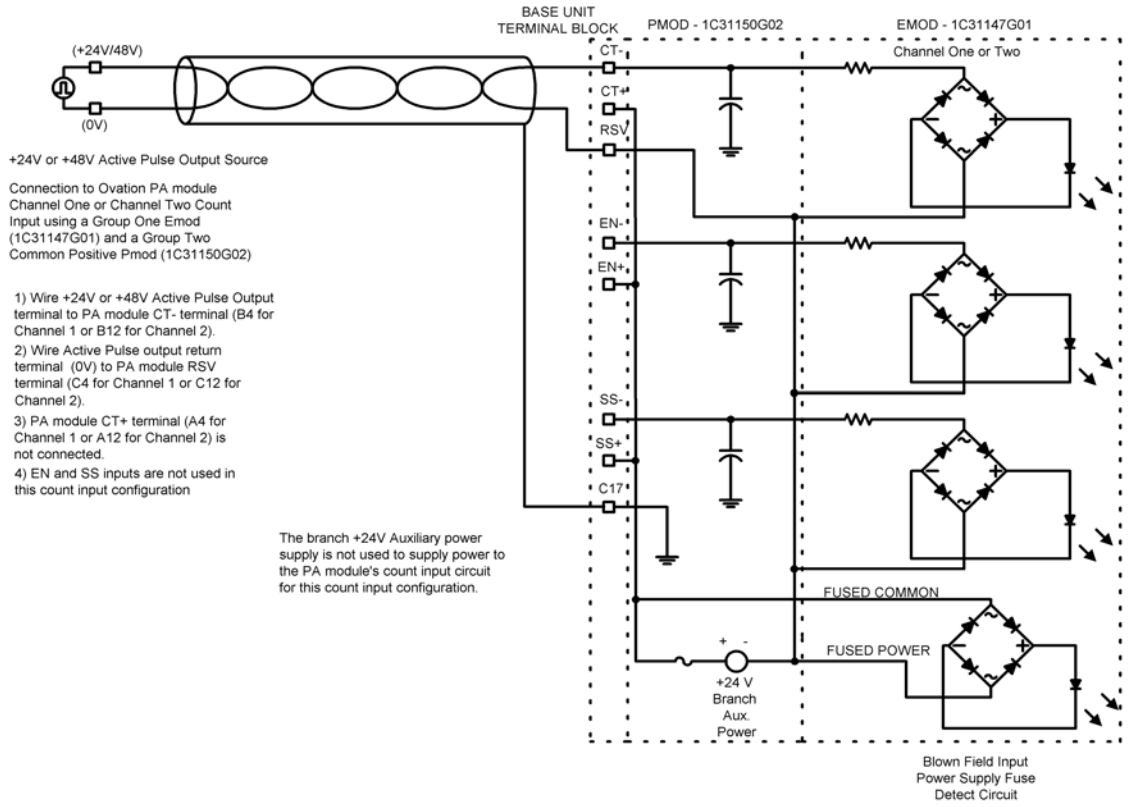

BASE UNIT
TERMINAL BLOCK
PMOD - 1C31150G02
EMOD - 1C31147G01
Channel One or Two
(+24V/48V)
(0V)
CT-
CT+
RSV
EN-
EN+
SS-
SS+
C17
+24V or +48V Active Pulse Output Source
Connection to Ovation PA module Channel One or Channel Two Count Input using a Group One Emod (1C31147G01) and a Group Two Common Positive Pmod (1C31150G02)
1) Wire +24V or +48V Active Pulse Output terminal to PA module CT- terminal (B4 for Channel 1 or B12 for Channel 2).
2) Wire Active Pulse output return terminal (0V) to PA module RSV terminal (C4 for Channel 1 or C12 for Channel 2).
3) PA module CT+ terminal (A4 for Channel 1 or A12 for Channel 2) is not connected.
4) EN and SS inputs are not used in this count input configuration
The branch +24V Auxiliary power supply is not used to supply power to the PA module's count input circuit for this count input configuration.
FUSED COMMON
FUSED POWER
+ -
+24 V Branch Aux. Power
Blown Field Input Power Supply Fuse Detect Circuit

Figure 111: 24V/48V Active Pulse Source Count Connections - Common Positive

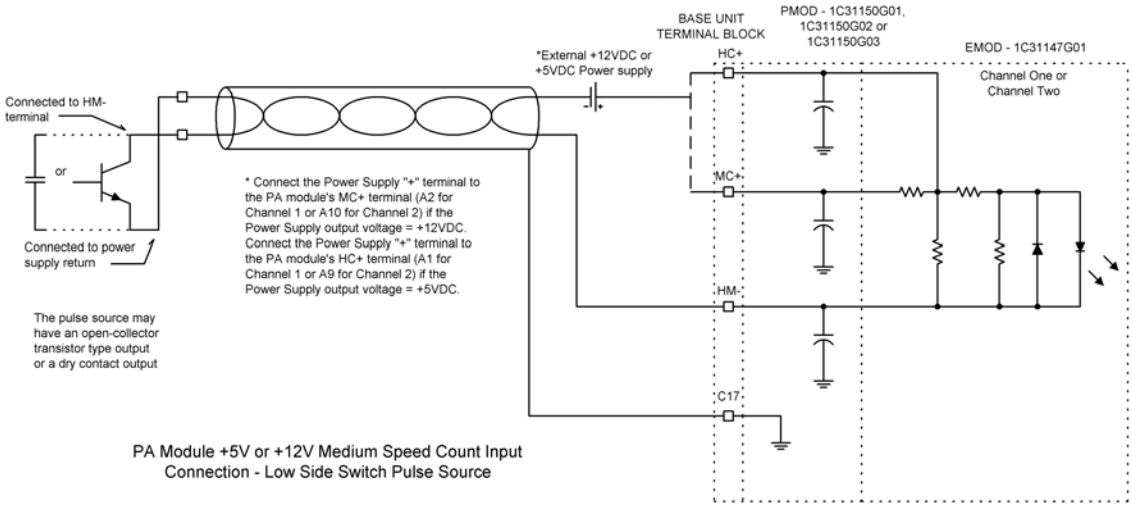

BASE UNIT
TERMINAL BLOCK
PMOD - 1C31150G01, 1C31150G02 or 1C31150G03
EMOD - 1C31147G01
Channel One or Channel Two
*External +12VDC or +5VDC Power supply
HC+
MC+
HM-
C17
Connected to HM- terminal
or
Connected to power supply return
* Connect the Power Supply "+" terminal to the PA module's MC+ terminal (A2 for Channel 1 or A10 for Channel 2) if the Power Supply output voltage = +12VDC. Connect the Power Supply "+" terminal to the PA module's HC+ terminal (A1 for Channel 1 or A9 for Channel 2) if the Power Supply output voltage = +5VDC.
The pulse source may have an open-collector transistor type output or a dry contact output
PA Module +5V or +12V Medium Speed Count Input Connection - Low Side Switch Pulse Source

Figure 112: +5V/+12V Medium Speed Count Connections - Low Side Switch Pulse Source (Non-CE Mark)

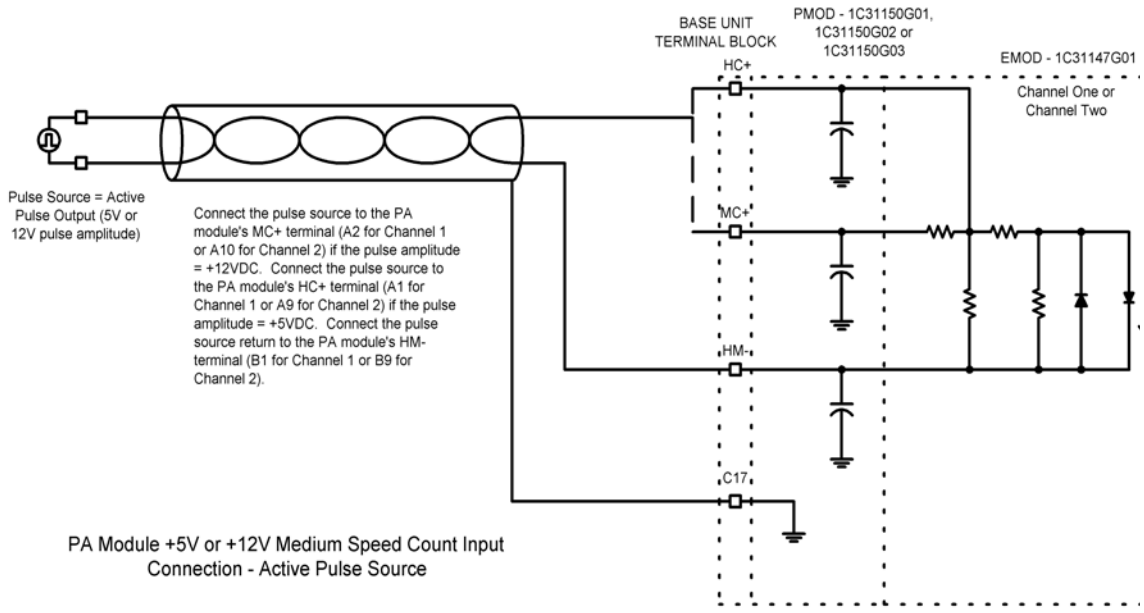
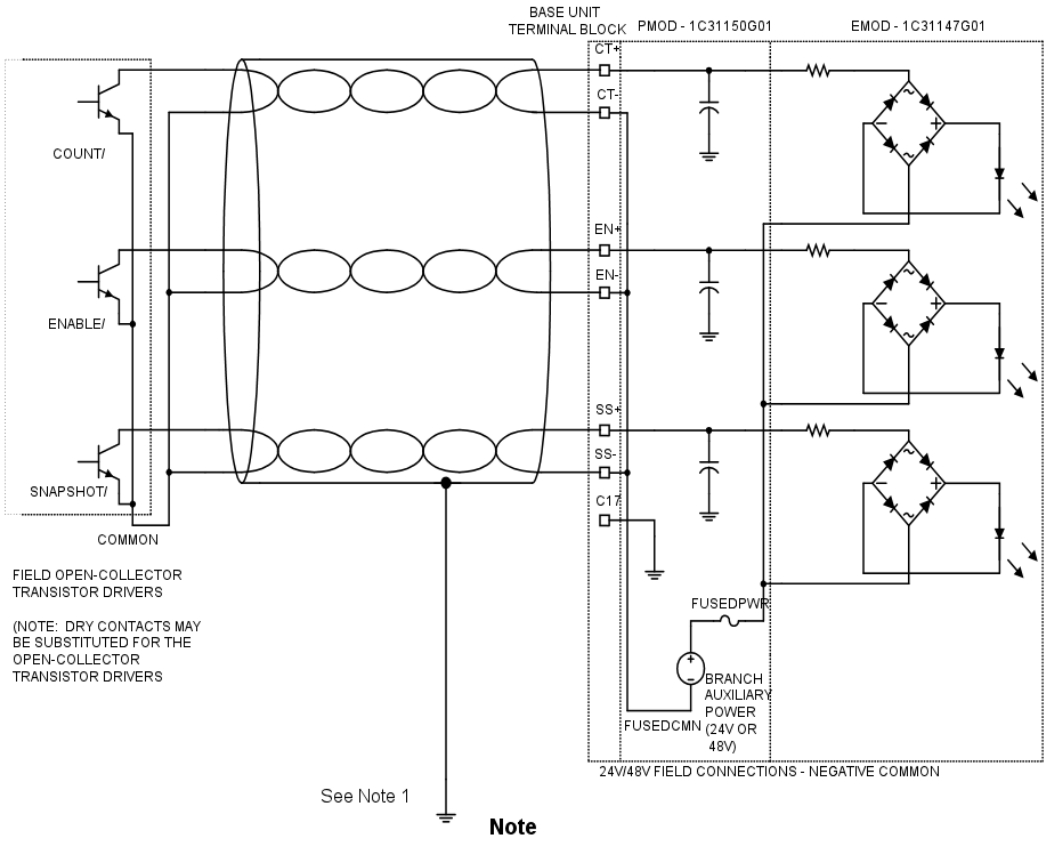

BASE UNIT
TERMINAL BLOCK
PMOD - 1C31150G01,
1C31150G02 or
1C31150G03
EMOD - 1C31147G01
Channel One or
Channel Two
HC+
MC+
HM-
C17
Pulse Source = Active
Pulse Output (5V or
12V pulse amplitude)
Connect the pulse source to the PA module's MC+ terminal (A2 for Channel 1 or A10 for Channel 2) if the pulse amplitude = +12VDC. Connect the pulse source to the PA module's HC+ terminal (A1 for Channel 1 or A9 for Channel 2) if the pulse amplitude = +5VDC. Connect the pulse source return to the PA module's HM- terminal (B1 for Channel 1 or B9 for Channel 2).
PA Module +5V or +12V Medium Speed Count Input
Connection - Active Pulse Source

Figure 113: +5V/+12V Medium Speed Count Connections - Active Pulse Source (Non-CE Mark)

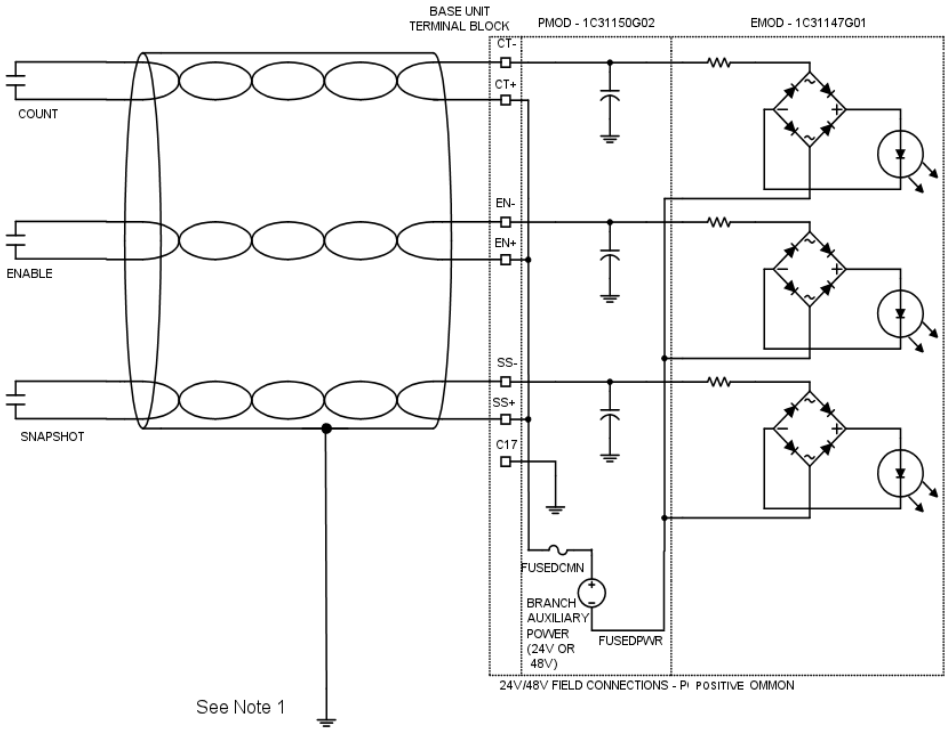
19.3.3 PULSE ACCUMULATOR FIELD CONNECTION WIRING DIAGRAMS (CE MARK CERTIFIED)



Note

1. All field wiring must be braid-shielded and grounded at the entry point of the cabinet using the recommended hardware (refer to the applicable "Cable Guidelines" information for your system).

Figure 114: 24V/48V Field Connections - Common Negative (CE Mark)



Note

1. All field wiring must be braid-shielded and grounded at the entry point of the cabinet using the recommended hardware (refer to the applicable "Cable Guidelines" information for your system).

Figure 115: 24V/48V Field Connections - Common Positive (CE Mark)

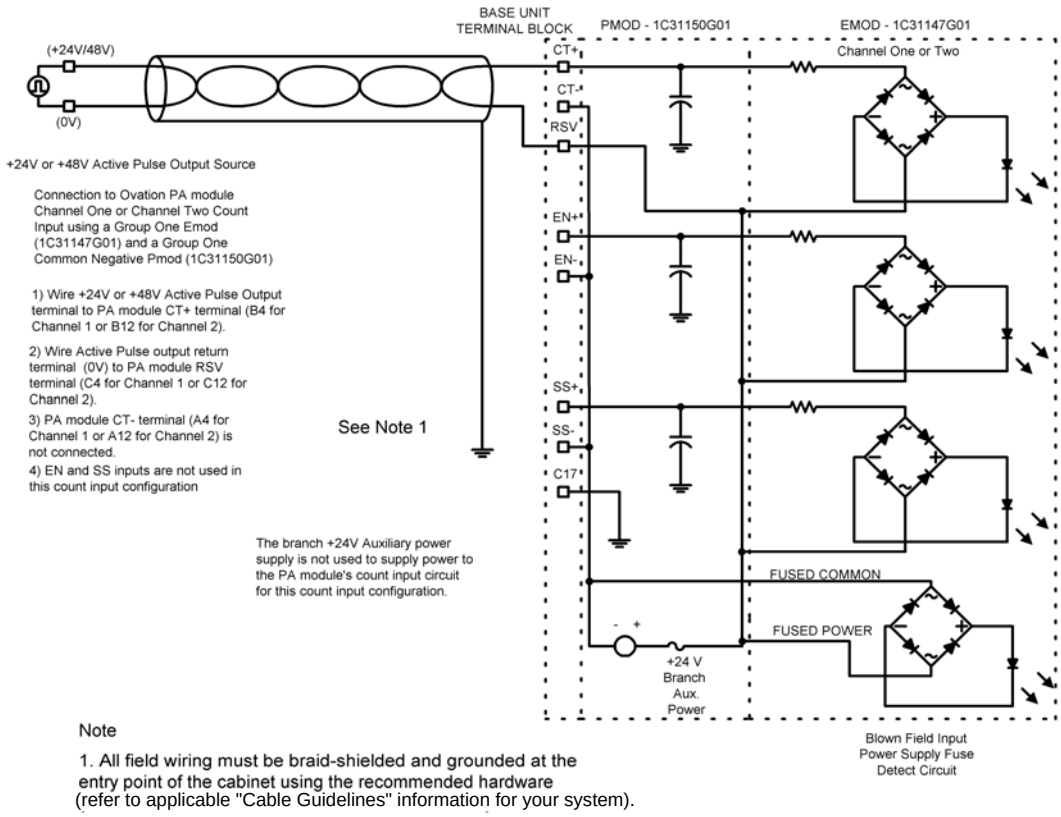

BASE UNIT
TERMINAL BLOCK
PMOD - 1C31150G01
EMOD - 1C31147G01
Channel One or Two
(+24V/48V)
(0V)
CT+
CT-
RSV
EN+
EN-
SS+
SS-
C17
+24V or +48V Active Pulse Output Source
Connection to Ovation PA module Channel One or Channel Two Count Input using a Group One Emod (1C31147G01) and a Group One Common Negative Pmod (1C31150G01)
1) Wire +24V or +48V Active Pulse Output terminal to PA module CT+ terminal (B4 for Channel 1 or B12 for Channel 2).
2) Wire Active Pulse output return terminal (0V) to PA module RSV terminal (C4 for Channel 1 or C12 for Channel 2).
3) PA module CT- terminal (A4 for Channel 1 or A12 for Channel 2) is not connected.
4) EN and SS inputs are not used in this count input configuration
See Note 1
The branch +24V Auxiliary power supply is not used to supply power to the PA module's count input circuit for this count input configuration.
FUSED COMMON
FUSED POWER
+24 V Branch Aux. Power
Blown Field Input Power Supply Fuse Detect Circuit
Note
1. All field wiring must be braid-shielded and grounded at the entry point of the cabinet using the recommended hardware (refer to applicable "Cable Guidelines" information for your system).

Figure 116: 24V/48V Active Pulse Source Count Connections - Common Negative

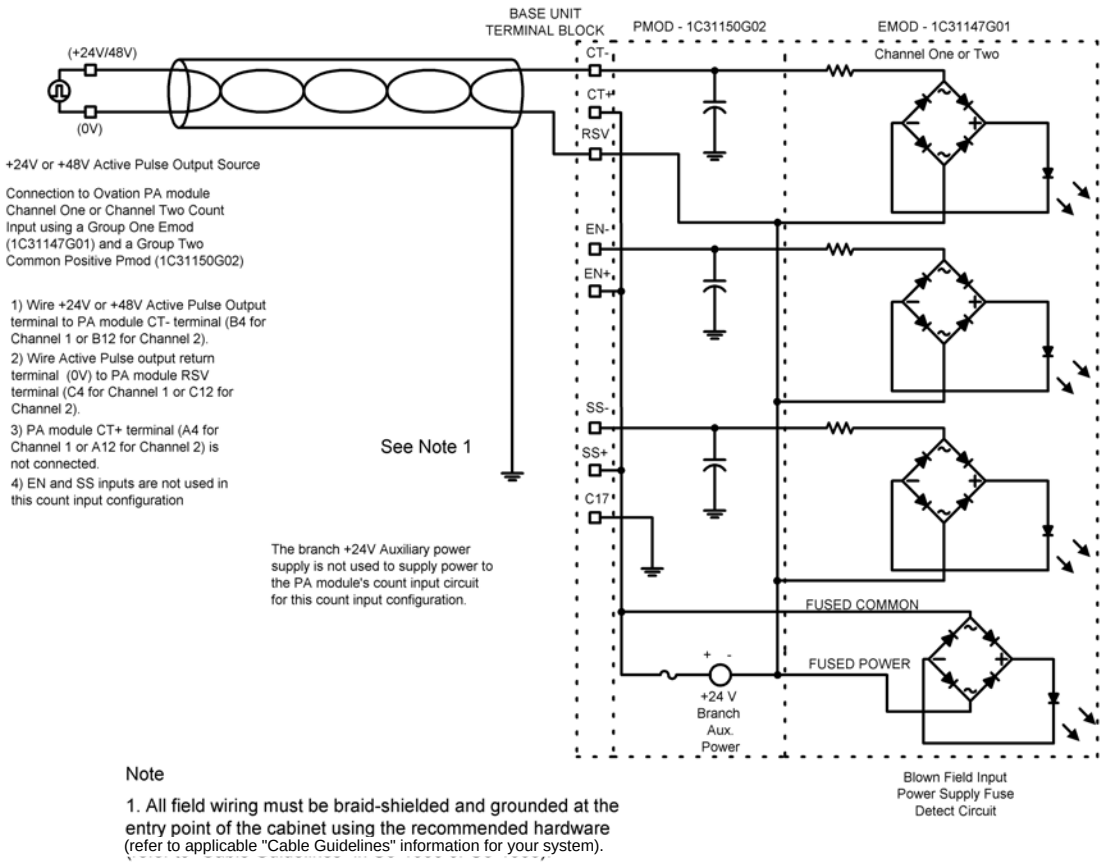

BASE UNIT
TERMINAL BLOCK
PMOD - 1C31150G02
EMOD - 1C31147G01
Channel One or Two
(+24V/48V)
(0V)
CT-
CT+
RSV
EN-
EN+
SS-
SS+
C17
+24V or +48V Active Pulse Output Source
Connection to Ovation PA module Channel One or Channel Two Count Input using a Group One Emod (1C31147G01) and a Group Two Common Positive Pmod (1C31150G02)
1) Wire +24V or +48V Active Pulse Output terminal to PA module CT- terminal (B4 for Channel 1 or B12 for Channel 2).
2) Wire Active Pulse output return terminal (0V) to PA module RSV terminal (C4 for Channel 1 or C12 for Channel 2).
3) PA module CT+ terminal (A4 for Channel 1 or A12 for Channel 2) is not connected.
4) EN and SS inputs are not used in this count input configuration
See Note 1
The branch +24V Auxiliary power supply is not used to supply power to the PA module's count input circuit for this count input configuration.
FUSED COMMON
FUSED POWER
+24 V Branch Aux. Power
Blown Field Input Power Supply Fuse Detect Circuit
Note
1. All field wiring must be braid-shielded and grounded at the entry point of the cabinet using the recommended hardware (refer to applicable "Cable Guidelines" information for your system).

Figure 117: 24V/48V Active Pulse Source Count Connections - Common Positive Pmod (CE Mark)

19.4 Address Location Information

19.4.1 Configuration and Status Register

Word address 13 (D in Hex) is used to configure the module and provide status information to the Controller. Bits 2 through 15 are for Channel 1. The status register can be read by using the Point Information window at an Operator Station (see the Bit Pattern field on the Hardware tab). (see *Ovation Operator Station User Guide*.)

Channel 1 Pulse Accumulator Configuration/Status Register (Address 13 or D in Hex)

Bit	Data Description - Configuration Register (Write)	Data Description - Status Register (Read)
0	Configure Module 1 = configure module so all module registers can be written to. 0 = unconfigure module, registers that are assigned offset addresses below 12 (C in Hex) cannot be written to, disables both pulse counters.	Module Configured 1 = module is configured and all module registers can be read from. 0 = module is not configured, registers that are assigned offset addresses below 12 (C in Hex) cannot be read from, both pulse counters are disabled.

BIT	DATA DESCRIPTION - CONFIGURATION REGISTER (WRITE)	DATA DESCRIPTION - STATUS REGISTER (READ)
1	Forced Internal Error 1 = force an attention status to be read by the Ovation Controller when it accesses registers with offset addresses less than 12 (C Hex) 0 = no forced error The logic card's ERROR signal is the logical OR of the Internal Error and External Error (Blown Fuse) status signals.	Forced Internal Error 1 = forced error set by the Ovation Controller. 0 = no forced error. The logic card's ERROR signal is the logical OR of the Internal Error and External Error (Blown Fuse) status signals.
2	Enable pulse counter 1 = enable pulse counter.	Enable pulse counter configuration bit status.
3	Reset on Snapshot 1 = reset pulse counter if a counter snapshot occurs. 0 = do not reset pulse counter if a counter snapshot occurs.	Reset on Snapshot configuration bit status.
4	Compare and Snapshot 1 = if the Compare register contents match the pulse counter contents, snapshot the pulse counter contents.	Compare and Snapshot configuration bit status.
5	De-bounce count input 1 = Enable the external COUNT input de-bounce circuit. 0 = Bypass the external COUNT input de-bounce circuit.	De-bounce count input configuration bit status.
6	Not Used	Blown Fuse (1 = Blown Personality module field input power supply fuse).
7	Reset on read 1 = Reset the pulse counter upon a Controller read of the Channel 1 Count register. 0 = Do not reset the pulse counter upon a Controller read of the Channel 1 Count register.	Reset on read configuration bit status.
8	Increment count upon trailing edge of pulse 1 = Increment the pulse counter upon the trailing edge of the external input COUNT pulse. 0 = Increment the pulse counter upon the leading edge of the external input COUNT pulse.	Increment count upon trailing edge of pulse configuration bit status.

BIT	DATA DESCRIPTION - CONFIGURATION REGISTER (WRITE)	DATA DESCRIPTION - STATUS REGISTER (READ)
9	Snapshot on trailing edge of external signal 1 = Snapshot the pulse counter contents upon the trailing edge of the external SNAPSHOT input. 0 = Snapshot the pulse counter contents upon the leading edge of the external SNAPSHOT input.	Snapshot on trailing edge of external signal configuration bit status.
10	ENABLE for counter OFF input 1 = The assertion of the external ENABLE input disables the pulse counter. 0 = The assertion of the external ENABLE input enables the pulse counter.	ENABLE for counter OFF input configuration bit status.
11	Disable de-bounce on ENABLE and SNAPSHOT inputs. 1 = Bypass the external ENABLE and SNAPSHOT inputs de-bounce circuits. 0 = Enable the external ENABLE and SNAPSHOT inputs de-bounce circuits.	Disable de-bounce on ENABLE and SNAPSHOT inputs configuration bit status.
12	Not Used	1 = The external ENABLE input is asserted 0 = The external ENABLE input is not asserted.
13	Not Used	Not Used.
14 - 15	00 = Pulse counter input is the external COUNT input. 01 = Pulse counter input is the 1 Khz internal timebase. 10 = Pulse counter input is the 10 Khz internal timebase. 11 = Pulse counter input is the 100 Khz internal timebase. Count Select Bits.	Count Select Bit configuration bits status.

19.4.2 SECONDARY CONFIGURATION AND STATUS REGISTER

Word address 14 (E in Hex) provides Channel 2 configuration and status.

Channel 2 Pulse Accumulator Configuration/Status Register (Address 14 or E in Hex)

BIT	DATA DESCRIPTION - CONFIGURATION REGISTER (WRITE)	DATA DESCRIPTION - STATUS REGISTER (READ)
0	Not Used	Not Used
1	Not Used	Not Used
2	Enable pulse counter 1 = enable pulse counter.	Enable pulse counter configuration bit status.
3	Reset on Snapshot 1 = reset pulse counter if a counter snapshot occurs. 0 = do not reset pulse counter if a counter snapshot occurs.	Reset on Snapshot configuration bit status.
4	Compare and Snapshot 1 = if the Compare register contents match the pulse counter contents, snapshot the pulse counter contents.	Compare and Snapshot configuration bit status.
5	De-bounce count input 1 = Enable the external COUNT input de-bounce circuit. 0 = Bypass the external COUNT input de-bounce circuit.	De-bounce count input configuration bit status.
6	Not Used	Blown Fuse 1 = Blown Personality module field input power supply fuse.
7	Reset on read 1 = Reset the pulse counter upon a Controller read of the Channel 1 Count register. 0 = Do not reset the pulse counter upon a Controller read of the Channel 1 Count register.	Reset on read configuration bit status.
8	Increment count upon trailing edge of pulse 1 = Increment the pulse counter upon the trailing edge of the external input COUNT pulse. 0 = Increment the pulse counter upon the leading edge of the external input COUNT pulse.	Increment count upon trailing edge of pulse configuration bit status.

BIT	DATA DESCRIPTION - CONFIGURATION REGISTER (WRITE)	DATA DESCRIPTION - STATUS REGISTER (READ)
9	Snapshot on trailing edge of external signal 1 = Snapshot the pulse counter contents upon the trailing edge of the external SNAPSHOT input. 0 = Snapshot the pulse counter contents upon the leading edge of the external SNAPSHOT input.	Snapshot on trailing edge of external signal configuration bit status.
10	ENABLE for counter OFF input 1 = The assertion of the external ENABLE input disables the pulse counter. 0 = The assertion of the external ENABLE input enables the pulse counter.	ENABLE for counter OFF input configuration bit status.
11	Disable de-bounce on ENABLE and SNAPSHOT inputs 1 = Bypass the external ENABLE and SNAPSHOT inputs de-bounce circuits. 0 = Enable the external ENABLE and SNAPSHOT inputs de-bounce circuits.	Disable de-bounce on ENABLE and SNAPSHOT inputs configuration bit status.
12	Not Used	1 = The external ENABLE input is asserted. 0 = The external ENABLE input is not asserted.
13	Not Used	Not Used
14 - 15	00 = Pulse counter input is the external COUNT input. 01 = Pulse counter input is the 1 Khz internal timebase. 10 = Pulse counter input is the 10 Khz internal timebase. 11 = Pulse counter input is the 100 Khz internal timebase. Count Select Bits.	Count Select Bit configuration bits status

19.5 DIAGNOSTIC LEDS

The following table lists the module's LEDs and describes what they mean when lit.

Diagnostic LEDs

LED	DESCRIPTION
P (Green)	Power OK LED. Lit when the +5V power is OK.
C (Green)	Communications OK LED. Lit when the Controller is communicating with the Pulse Accumulator module.
E (Red)	External Fault LED.[1] Lit when the field supply fuse is blown. (Bit 6) of the Status Register (see page 283) is set.
I (Red)	Internal Fault LED.[1] Lit whenever the Force Error bit (Bit 1) of the Configuration Register (see page 283) is set or when a timeout of the watchdog timer occurs when the Controller stops communicating with the module.
CH1 - CH 2 (Green)	Lit when the Channel external ENABLE input is active.
[1] The logical OR of the Internal Fault LED and External Fault LED indication is input to the IO Slave Controller as an ERROR flag. This forces an attention status.	

19.6 SPECIFICATIONS

Electronics Module (1C31147)

Personality Module (1C31150)

Pulse Accumulator Specifications

DESCRIPTION	VALUE
Number of channels	2
Field input voltage range [1]	Field count: +5V (high speed) +5/12V (medium speed) + 24/48V Field controls: +24/48V
24/48 V field input power [2]	Common positive (1C31150G02) Common negative (1C31150G01) Dedicated (user-defined) contact power (1C31150G03)
Configurable functions	Count pulses Measure pulse width Measure period Measure speed
Counter output	15 bit count (bits 14 - 0) Bit 15 (MSB) is an update bit indicating new data available Counter overflow status

DESCRIPTION	VALUE
Field inputs	External count input (leading or trailing edge) OR Selectable internal timebase: 100 Khz, 10 Khz, 1 Khz See the table below for more information.
Input filter	+5V High Speed Count: 1 µSec. to 5 µSec. +5/12V Medium Speed Count: 16 µSec. to 38 µSec. +24/48V Count:150 µSec to 450 µSec +24/48V Controls: 150 µSec to 450 µSec
Contact debounce (24/48 V field inputs)	Configurable: Minimum: 1.4 mSec Maximum: 2.0 mSec
Dielectric isolation: Channel to channel Channel to logic	 1000V AC/DC 1000V AC/DC
Operating temperature range	0 to 60°C (32°F to 140°F)
Storage temperature range	-40°C to 85°C (-40°F to 185°F)
Humidity (non-condensing)	0 to 95%
Module power from logic supply	Main: 1.6 W typical: 2.0 W maximum Aux: When used, both count inputs = 50% duty cycle 0.17 W (24V) typical 0.35 W (48V) typical
[1] All field inputs must be in a shielded cable. [2] Open loop/blown fuse detection for 24/48V power.	

Field Input Pulse Accumulator Specifications

COUNT INPUTS	ON TIME MSEC. MIN.	OFF TIME MSEC. MIN.	COUNT RATE MAX.	DESCRIPTION
Count Outputs				
(MC+/HM-) 12V (HC+/HM-) 5V	0.03	0.03	20 kHz	Medium speed without de-bounce circuit enabled (1C31147G01)
(MC+/HM-) 12V (HC+/HM-) 5V	2.5	2.5	200 Hz	Medium speed with de-bounce circuit enabled (1C31147G01)
(HC+/HM-) 5V	0.007	0.007	70 kHz	High speed without de-bounce circuit enabled (1C31147G02)
(HC+/HM-) 5V	2.5	2.5	200 Hz	High speed with de-bounce circuit enabled (1C31147G02)
(CT+/CT-) 24V/48V	1	1	500 Hz	Without de-bounce circuit enabled (1C31147G01)

COUNT INPUTS	ON TIME MSEC. MIN.	OFF TIME MSEC. MIN.	COUNT RATE MAX.	DESCRIPTION
(CT+/CT-) 24V/48V	2.5	2.5	200 Hz	With de-bounce circuit enabled (1C31147G01)
Control Inputs				
24V/48V	1	1	500 Hz	Without de-bounce circuit enabled
24V/48V	2.5	2.5	200 Hz	With de-bounce circuit enabled

19.6.1 INPUT SIGNAL LEVELS

5/12 Volt Medium Speed COUNT Input Signals

VOLTAGE	VIN OFF	Vin ON			IIN OFF	Iin ON		
	V max.	V min.	V nom.	V max.	ma max.	ma min.	ma nom.	ma Max
5V Input	0.8	3.9	--	5.0	1.5	12.0	--	21.0
12V Input	0.8	9.75	--	12.5	1.5	12.0	--	21.0

The 5V medium speed COUNT input impedance is typically 250 ohms. This is a two leaded input signal.

5 Volt High Speed COUNT Input Signals

VIN OFF	Vin ON			IIN OFF	Iin ON		
V max.	V min.	V nom.	V max.	ma max.	mA min.	mA nom.	mA Max
0.8	3.9	--	5.0	3.0	25.0	--	42.0

The 5V high speed COUNT input impedance is typically 125 ohms. This is a two-leaded input signal

24/48 Volt Medium Speed COUNT Input Signals

INPUT LEVEL	ON Input Volts		OFF INPUT VOLTS	ON Input mA		OFF INPUT MA
	min.	max.	max.	min.	max.	max.
Control Signals						
24 VDC	18	60	9	2.0	5.1	0.6
48 VDC	18	60	9	2.0	5.1	0.6
Count Signals						
24 VDC	18	60	9	3.0	7.7	0.9
48 VDC	18	60	9	3.0	7.7	0.9

This signal level applies to the control inputs and to the 24/48 Volt COUNT input depending upon the group and the wiring.

This input accepts either a 24V or 48V input. The Electronics Module accepts a positive or a negative field signal common. The Personality Module determines if the field signal common is positive or negative.

SECTION 20

RELAY OUTPUT MODULE

IN THIS SECTION

Description *291*
Module Group Information *291*
Module Specific Information *293*
Wiring Information *295*
Address Location Information *301*
Diagnostic LEDs *302*
Specifications *303*

20.1 DESCRIPTION

An Ovation Relay Output module consists of an Electronics module, a base assembly, and relays. The Relay Output module provides a means to switch high AC voltages at high currents to field devices. There are two versions of the Relay Output base assembly which contain either 12 or 16 relays within each base. The 12 Relay Output base assembly provides the additional advantage of being able to switch larger DC voltages at high currents.

Each Relay Output base assembly incorporates an integral Relay Output Electronics module to interface between the relays and the Ovation I/O Controller. The Relay Output Electronics module provides configurable communication timeout periods and LEDs to indicate the status of each output.

The Relay Output module is applicable for CE Mark certified systems.

Note: *I/O Module General Information (see page 15) contains environmental, installation, wiring, and fuse information for I/O modules.*

20.2 MODULE GROUP INFORMATION

20.2.1 ELECTRONIC MODULE (EMOD)

There is one Electronics module group for the Relay Output module:

- **1C31219G01** provides an interface between the Ovation Controller and the mechanical relays that are used to switch high AC voltages at high currents. This module plugs into the Relay Output base assembly.

Note: *The Relay Output base assembly does not incorporate a Personality module.*

Relay Output Base Assemblies

There are two different styles of Relay Output base assemblies:

- 1C31223G01 is configured with 16 Form C (G2R style) relays which switch high AC voltages at high currents. Each relay contains one Form C contact arrangement which is brought to terminal blocks for user connections.
- 1C31222G01 is configured at the project level with either 12 Form C (KUEP style) or 12 Form X (KUEP style) relays which switch high AC and DC voltages at high currents.

  In the case of the Form C relay, only one of the contact pairs within the relay is available at the terminal blocks for user connection. The KUEP style relay bases (1C31222G01) have the advantage of being able to switch larger DC voltages at higher currents than the G2R style relay bases (1C31223G01).

Relay Output Module Subsystem [1]

DESCRIPTION	CHANNELS	ELECTRONIC MODULE	BASE UNIT [2]
KUEP Relay Panel (Form C)	12	1C31219G01	1C31222G01
KUEP Relay Panel (Form X)	12	1C31219G01	1C31222G01
G2R Relay Panel	16	1C31219G01	1C31223G01

[1] All Configurations are CE Mark certified.

[2] Relay Outputs do not use standard Ovation I/O bases. Use the listed base units for Relay Output applications. Also note that the Relay Output module does not use a Personality module.

Relay Contact Ratings must be adhered to when utilizing the Relay Output Module Assemblies. The application must include external current limiting protection for the Relay Output Module Assemblies.

Relay Output Panel Kits

There are four different styles of Relay Output panel kits:

- 5A26457G01 contains a Relay Output Electronics module a relay output base assembly, and 16 Form C relays (G2R style).
- 5A26458G01 contains a Relay Output Electronics module, a relay output base assembly, and 12 Form C relays (KUEP style).
- 5A26458G02 contains a Relay Output Electronics module, a relay output base assembly, and 12 Form X relays (KUEP style).
- 5A26458G03 contains a Relay Output Electronics module, and a relay output base assembly. This is a project specific base assembly in which the project determines the mix of the Form C and Form X relays on a panel. The KUEP Form C relay is 4960A71H16 and the KUEP Form X relay is 4960A71H05.

CAUTION! When using the Relay Output base, the power distribution panel should be equipped with a jumper Module 5A26471G01 that connects the returns for the auxiliary power supply and main power supply.

In applications where all radial power terminal block connectors on the power distribution are required for cabling, Cable 5A26472Gxx should be employed that incorporates the jumper into the cable assembly.

The jumper 5A26471G01or cable 5A26472Gxx ties auxiliary power return to earth ground locally via cabinet grounding. Therefore, to avoid potential ground loops, do not ground auxiliary power to any other point.

Auxiliary power is bussed (via PCB traces) to all bases in any given branch. Relay Output bases must be installed only on I/O branches containing +25V typical Aux power (before auctioneering diode drop within Ovation auxiliary power supply).

Do NOT install Relay Output modules/bases on the same branch with Ovation bases with different voltage wired as Aux power (for example, DI modules using 125V AC).

20.3 Module Specific Information

20.3.1 External Power Supplies

It is recommended that the Relay Output base assembly obtain relay coil voltage from the internal Ovation auxiliary power supplies. These supplies distribute power through the Controller backplane and ROP panel to base assemblies. Use of external power supplies for relay coil power is **NOT** recommended.

20.3.2 USING RELAY OUTPUT BASES

Proper relay operation is temperature dependent and is determined by the following:

- Temperature rise of the coil after being energized for extended periods.
- Temperature rise of the coil due to large relay contact currents.
- Ambient temperature.

The table below provides general user guidelines which can be referenced when configuring cabinets with Relay Output bases.

Operating Temperature Summary for Relay Output Bases

CABINET TYPE	AMBIENT CABINET OPERATING TEMPERATURE	RELAY BASE STYLE
Controller	0 to 50°C (32 to 122°F)	G2R
Extended I/O	0 to 60°C (32 to 140°F)	G2R
Remote I/O (Ventilated)	0 to 60°C (32 to 140°F)	G2R
Remote I/O (Sealed)	0 to 50°C (32 to 122°F) @ 175 W maximum	G2R
Remote I/O (Sealed)	0 to 40°C (32 to 104°F) @ 225 W maximum	G2R
Controller	0 to 50°C (32 to 122°F)	KUEP Form X
Extended I/O	0 to 60°C (32 to 140°F)	KUEP Form X
Remote I/O (Ventilated)	0 to 60°C (32 to 140°F)	KUEP Form X
Remote I/O (Sealed)	0 to 50°C (32 to 122°F) @ 175 W maximum	KUEP Form X
Remote I/O (Sealed)	0 to 40°C (32 to 104°F) @ 225 W maximum	KUEP Form X
Controller	0 to 40°C (32 to 104°F)	KUEP Form C
Extended I/O	0 to 45°C (32 to 113°F)	KUEP Form C
Remote I/O (Ventilated)	0 to 45°C (32 to 113°F)	KUEP Form C
Remote I/O (Sealed)	0 to 35°C (32 to 95°F) @ 175 W maximum	KUEP Form C
Remote I/O (Sealed)	0 to 25°C (32 to 77°F) @ 225 W maximum	KUEP Form C

20.3.3 Blown Fuse Detection Circuit

Bit 6 in the status register enables the Controller to monitor the status of the field supply fuse, and it gives a visual indication of the status via the “EXTERNAL ERROR (see page 302)” LED.

The Controller enables this feature by writing a “1” to Bit 7 of the configuration register. If enabled and the field supply voltage is between 18VDC and 25.5VDC, the circuit indicates the field supply fuse is OK by turning OFF the “EXTERNAL ERROR” LED and clearing Bit 6 of the module status register. If enabled and the field supply voltage is less than 0.4VDC, the circuit indicates the field supply fuse is blown by turning ON the “EXTERNAL ERROR” LED and setting Bit 6 of the module status register.

In summary, this feature is specified to operate as follows:

- 18VDC < Field supply voltage < 25.5VDC => Fuse is OK
- 0.4VDC < Field supply voltage < 18VDC => UNDEFINED
- Field supply voltage < 0.4VDC => Fuse is blown
- After a powering reset, the blown fuse detection circuit is disabled.

20.4 Wiring Information

20.4.1 Relay Output Terminal Block Wiring Information

Each relay base assembly employs terminal blocks which are permanently marked with appropriate relay contact designations at each position. The terminal block marking indicates how field wiring is connected to each terminal block position in the respective relay base assemblies.

The terminal block markings for the G2R style relay output base assembly and for the KUEP style Relay Output base assemblies are illustrated below. The following table lists and defines the abbreviations used in those diagrams.

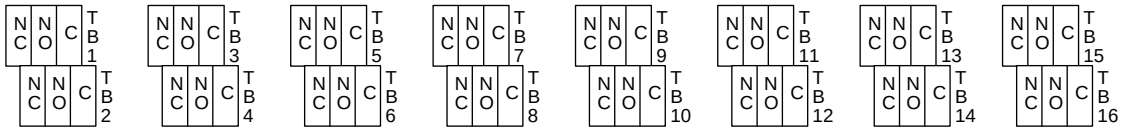

NC NO C TB 1
NC NO C TB 2
NC NO C TB 3
NC NO C TB 4
NC NO C TB 5
NC NO C TB 6
NC NO C TB 7
NC NO C TB 8
NC NO C TB 9
NC NO C TB 10
NC NO C TB 11
NC NO C TB 12
NC NO C TB 13
NC NO C TB 14
NC NO C TB 15
NC NO C TB 16

Figure 118: Terminal Block Connections for the G2R Relay Output Base Assembly

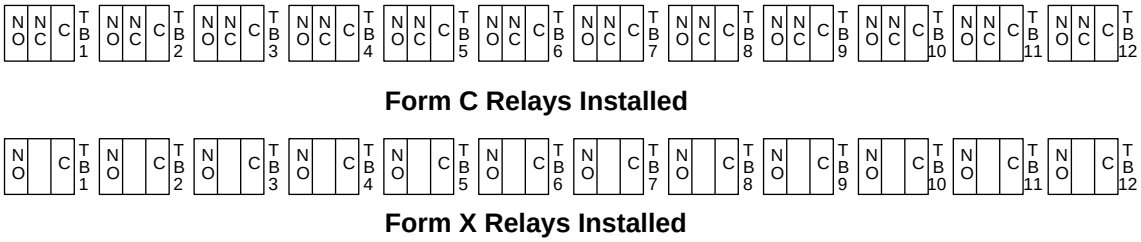

NO NC C TB 1
NO NC C TB 2
NO NC C TB 3
NO NC C TB 4
NO NC C TB 5
NO NC C TB 6
NO NC C TB 7
NO NC C TB 8
NO NC C TB 9
NO NC C TB 10
NO NC C TB 11
NO NC C TB 12
Form C Relays Installed
NO C TB 1
NO C TB 2
NO C TB 3
NO C TB 4
NO C TB 5
NO C TB 6
NO C TB 7
NO C TB 8
NO C TB 9
NO C TB 10
NO C TB 11
NO C TB 12
Form X Relays Installed

Figure 119: Terminal Block Connections for the KUEP Relay Output Base Assembly

Abbreviations Used in Diagrams

ABBREVIATION	DEFINITION
NC [1]	Normally Closed contact connection
NO	Normally Open contact connection
C	Common contact connection

[1] Do **NOT** use the NC terminal position when using the KUEP style base assembly with a Form X style relay inserted. The terminal position should remain unconnected.

20.4.2 Relay Output Terminal Block Wiring Information

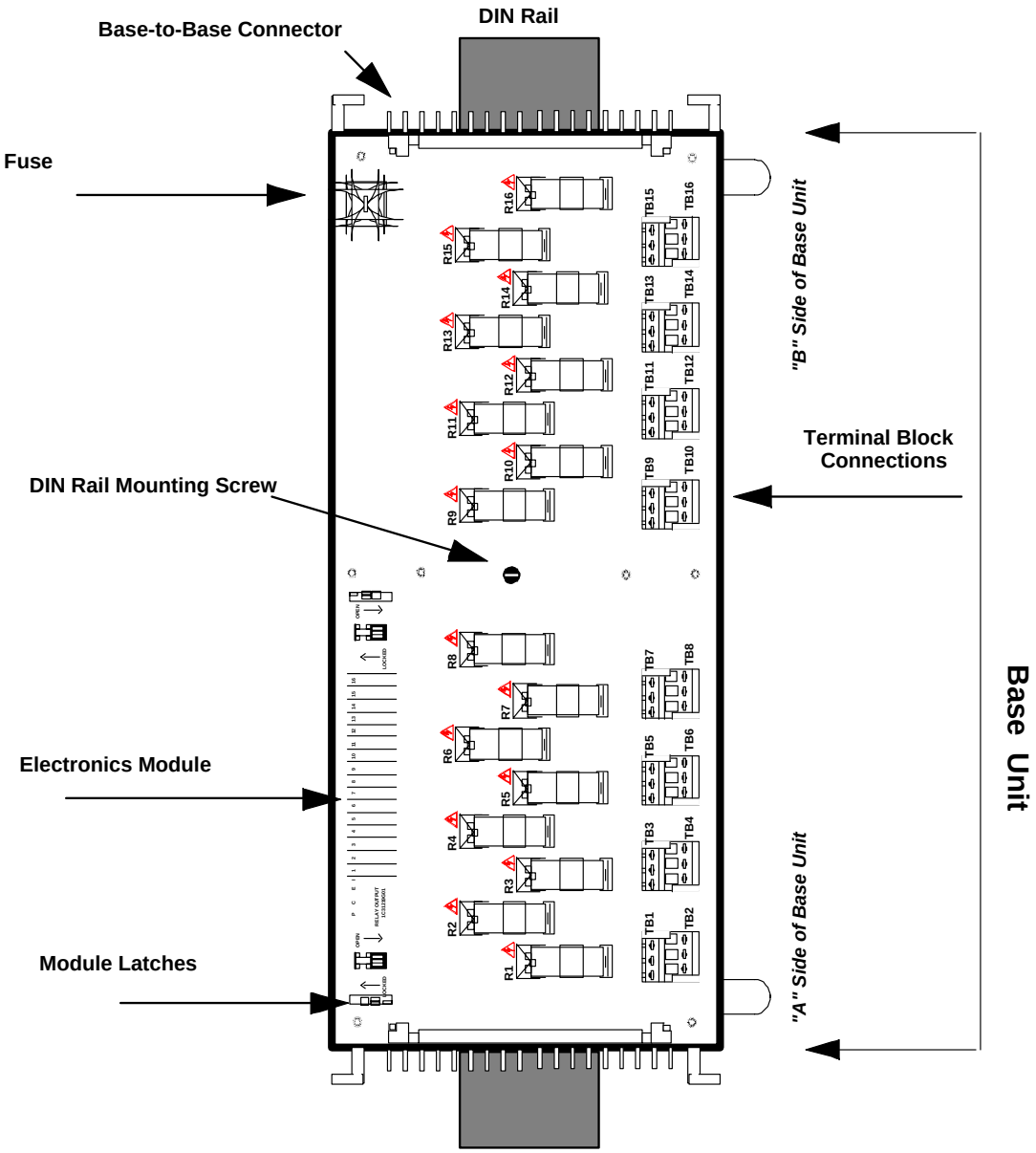


Figure 120: Relay Output Panel G2R

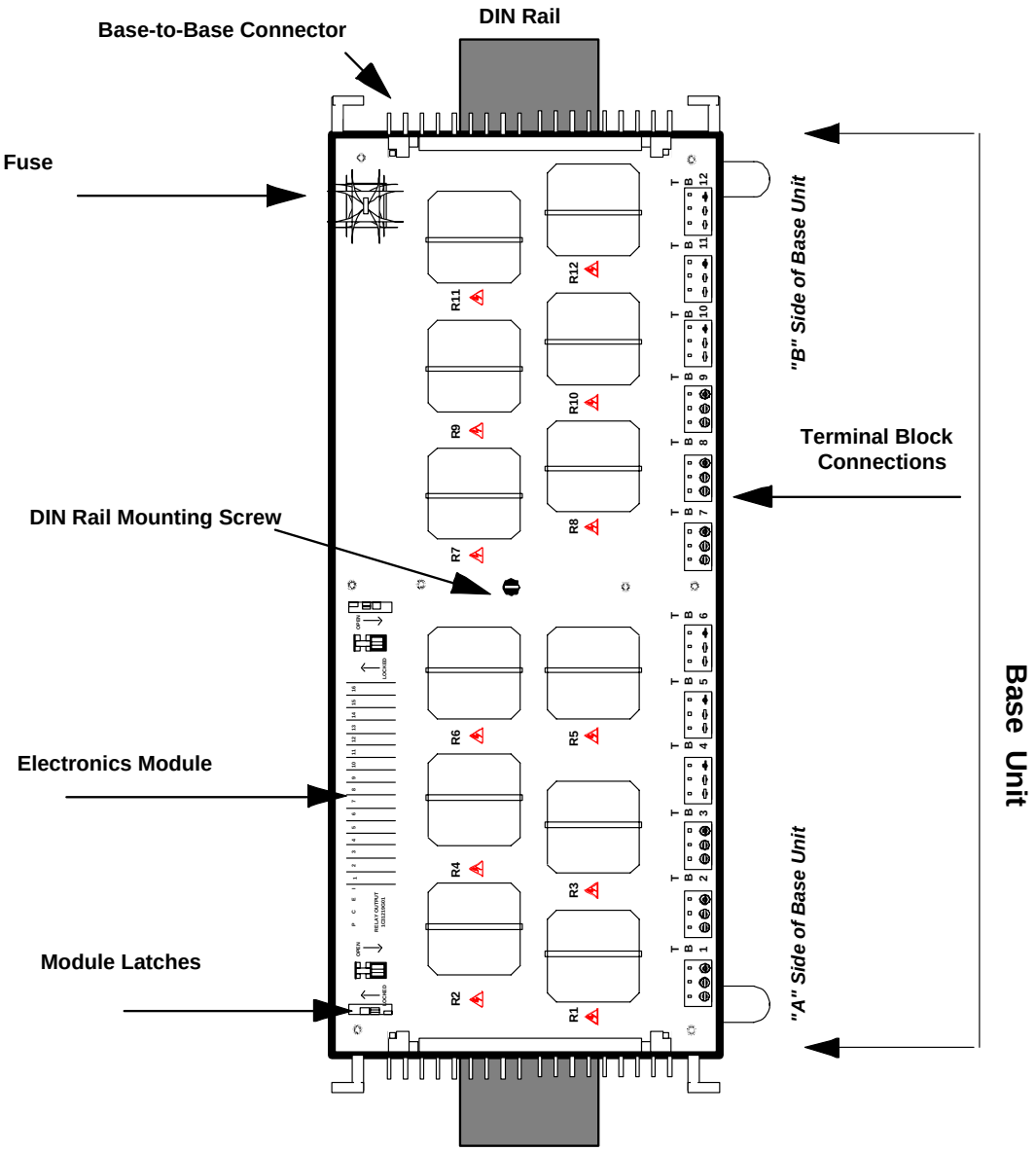


Figure 121: Relay Output KUEP

20.4.3 RELAY OUTPUT FIELD CONNECTION WIRING DIAGRAMS (NON-CE MARK CERTIFIED)

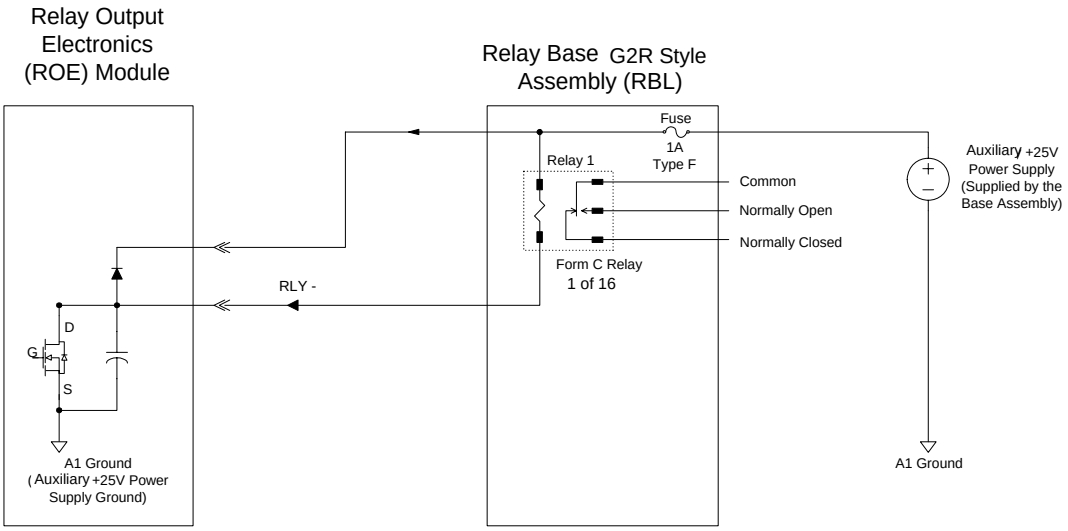


Figure 122: Relay Base G2R Style Assembly Field Wiring (Non-CE Mark)

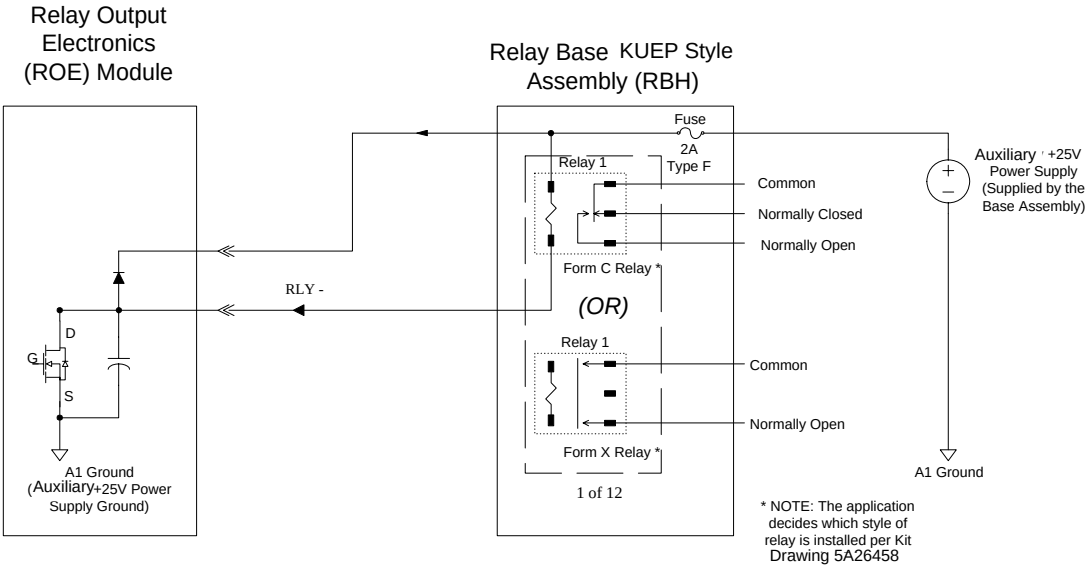


Figure 123: Relay Base KUEP Style Assembly Field Wiring (Non-CE Mark)

20.4.4 RELAY OUTPUT FIELD CONNECTION WIRING DIAGRAMS (CE MARK CERTIFIED)

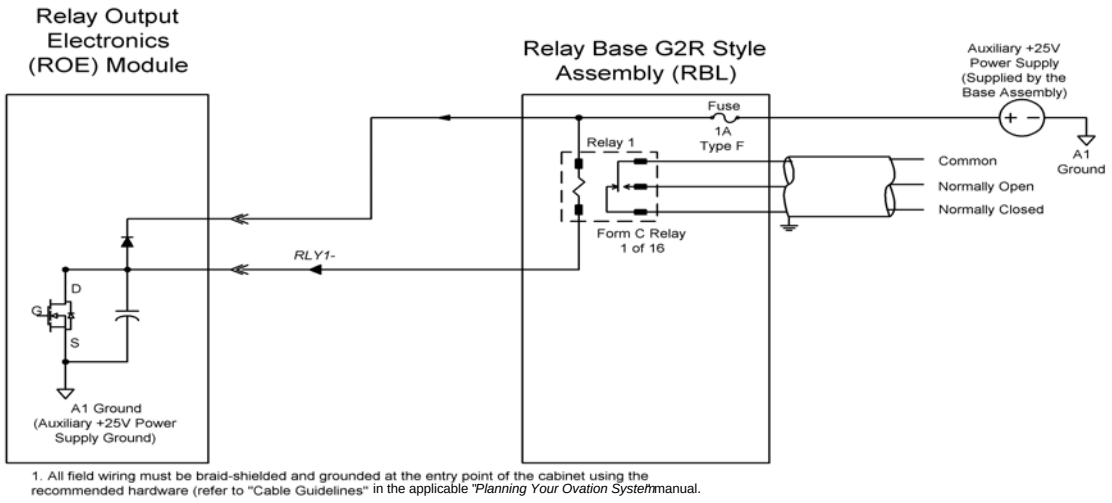

Relay Output Electronics (ROE) Module
Relay Base G2R Style Assembly (RBL)
Auxiliary +25V Power Supply (Supplied by the Base Assembly)
Fuse
1A
Type F
Relay 1
Common
Normally Open
Normally Closed
A1 Ground
Form C Relay
1 of 16
RLY1-
D
G
S
A1 Ground
(Auxiliary +25V Power Supply Ground)
1. All field wiring must be braid-shielded and grounded at the entry point of the cabinet using the recommended hardware (refer to "Cable Guidelines" in the applicable "Planning Your Ovation System" manual.

Figure 124: Relay Base G2R Style Assembly Field Wiring (CE Mark)

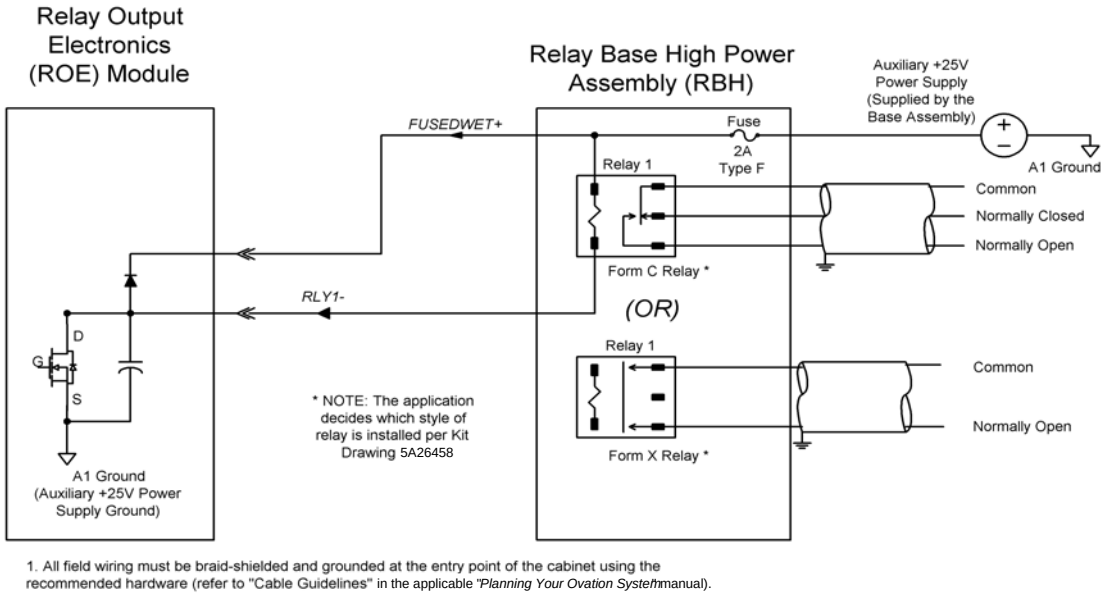

Relay Output Electronics (ROE) Module
Relay Base High Power Assembly (RBH)
Auxiliary +25V Power Supply (Supplied by the Base Assembly)
FUSEDWET+
Fuse
2A
Type F
Relay 1
A1 Ground
Common
Normally Closed
Normally Open
Form C Relay *
RLY1-
(OR)
Relay 1
Common
Normally Open
Form X Relay *
D
G
S
* NOTE: The application decides which style of relay is installed per Kit Drawing 5A26458
A1 Ground
(Auxiliary +25V Power Supply Ground)
1. All field wiring must be braid-shielded and grounded at the entry point of the cabinet using the recommended hardware (refer to "Cable Guidelines" in the applicable "Planning Your Ovation System" manual).

Figure 125: Relay Base KUEP Style Assembly Field Wiring (CE Mark)

20.5 Address Location Information

20.5.1 Configuration and Status Register

Word address 13 (D in Hex) is used to configure the module and provide status information to the Controller. The status register can be read by using the Point Information window at an Operator Station (see the Bit Pattern field on the Hardware tab). (See *Ovation Operator Station User Guide.)*

Relay Output Configuration/Status Register (Address 13 or D in Hex)

Bit	Data Description - Configuration Register (Write)	Data Description - Status Register (Read)
0	Configured (active high)	Configured (active high) (1 = configured; 0 = unconfigured)
1	Forced Error (active high)	Forced Error (active high) (1 = forced error; 0 = no forced error)
2 - 4	Communications Timeout Setting [1] Bit 4 / Bit 3 / Bit 2 / Timeout 0 0 0 16 seconds 0 0 1 4 seconds 0 1 0 2 seconds 0 1 1 1 seconds 1 0 0 500 milliseconds 1 0 1 250 milliseconds 1 1 0 125 milliseconds 1 1 1 62.5 milliseconds	Communications Timeout Setting [1] Bit 4 / Bit 3 / Bit 2 / Timeout 0 0 0 16 seconds 0 0 1 4 seconds 0 1 0 2 seconds 0 1 1 1 seconds 1 0 0 500 milliseconds 1 0 1 250 milliseconds 1 1 0 125 milliseconds 1 1 1 62.5 milliseconds
5	Outputs hold their state on communications timeout (active high)	Outputs hold their state on communications timeout (active high)
6	Not used	Indicates the status of the blown fuse detection circuit (high = field supply fuse is blown)
7	Enable blown fuse detection circuit (active high)	Enable blown fuse detection circuit (active high)
8	Not used	Base ID0 Bit [2] (Set by the Base Assembly)
9	Not used	Base ID1 Bit [2] (Set by the Base Assembly)
10	Not used	Base ID2 Bit [2] (Set by the Base Assembly)
11 - 15	Not used	Not used

[1] The tolerance on the timeout period is +/- 35%.

[2] Refer to the following table for Base ID values.

Bit 0: When Bit 0 is set, the module is configured. The Controller configures the module by writing a “1” to Bit 0 of the configuration register. Once configured, it remains configured until a power-up/down reset is generated. After a power-up condition the configuration register clears.

Bit 1: When Bit 1 is set, the internal error LED is turned on and data registers can be written but not read.

Bits 2-4: These bits are used to select the communication timeout period.

Bit 5: When Bit 5 is set, the digital outputs hold their last state on a communications watchdog timeout. When Bit 5 is cleared, the digital outputs are cleared (output transistor is shut off) on a communications watchdog timeout.

Bit 6: This bit indicates the status of the blown fuse detection circuit. When Bit 6 of the status register is set, the field supply fuse is blown (see page 295).

Bit 7: When Bit 7 is set, the blown fuse detection circuit is enabled.

Bits 8-10: The Base Assembly (KUEP or G2R style) straps three bits in hardware which identify which type of base the ROE is plugged into. The type of base can therefore be determined from reading these bits.

Bits 11-15: Not used.

Relay Output Base ID Bits

BIT 10 (BASE ID2)	BIT 9 (BASE ID1)	BIT 8 (BASE ID0)	BASE TYPE
0	0	0	KUEP Style
0	0	1	G2R Style
All others	All others	All others	Reserved for Future Use

20.6 DIAGNOSTIC LEDS

The following table lists the module’s LEDs and describes what they mean when lit.

Relay Output Diagnostic LEDs

LED	DESCRIPTION
P (Green)	Power OK LED. Lit when the +5V power is OK.
C (Green)	Communications OK LED. Lit when the Controller is communicating with the module.
E (Red)	External Fault LED. Lit when the field supply fuse is blown and the blown fuse detection circuit is enabled. Blown Fuse bit (Bit 7) of the Configuration Register (see page 301) enables or disables the fuse detection circuit (high = enabled).
I (Red)	Internal Fault LED. Lit whenever the Force Error bit (Bit 1 of the Configuration Register (see page 301)) is active or the Controller stops communicating with the module.
CH1 - CH 16 (Green)	If the LED is lit, this indicates that the output is in the ON state. If the LED is not lit, this indicates that the output is in the OFF state.

20.7 SPECIFICATIONS

Electronics Module (1C31219G01)
Base Assembly (1C31223G01, G2R Style)
Base Assembly (1C31222G01, KUEP Style)

Relay Output Electronics Module Specifications (1C31219G01)

DESCRIPTION	VALUE
Number of channels	16
Blown fuse detection [1] Operating voltage range	 18V ≤ auxiliary supply voltage ≤ 25.5V
Module power	Main: 1.88 W typical, 2.5 W maximum Auxiliary: 0.3 W typical, 0.35 W maximum
Operating temperature range	0 to 60°C (32°F to 140°F)
Storage temperature range	-40°C to 85°C (-40°F to 185°F)
Humidity (non-condensing)	0 to 95%
[1] You can configure the module to enable/disable the blown fuse detection function.	

Relay Output Base Specifications (1C31223G01, G2R Style)

DESCRIPTION	VALUE
Number of relays	16
Relay Type	G2R electromechanical style with 1 Form C contact style
Relay contact ratings	10 amps @250 VAC, PF=1 10 amps @30 VDC
Maximum propagation time	Operate time: 15 mSec, bounce approximately = 3 mSec Release time: 10 mSec, bounce approximately = 8 mSec
Dielectric isolation: Relay contacts to logic	 2300V AC/DC
Relay base power	Auxiliary power: 9.1 W typical, 11.68 W maximum
Auxiliary power supply [1]	25V typical (before output auctioneering diode drop within Ovation auxiliary power supply) 25.5V maximum@60°C
Operating temperature range [2]	0 to 60°C (32°F to 140°F)
Storage temperature range	-40 to 70°C (-40°F to 158°F)
Humidity (non-condensing)	35 - 85%
[1] Use of the internal Ovation auxiliary power supply is recommended for relay output modules. [2] See additional application derating (see page 294) information.	

Relay Output Base Assembly Specifications (1C31222G01, KUEP Style)

DESCRIPTION	VALUE
Number of channels	12
Relay Type	KUEP electromechanical style: 5A26458G01 Kit - 1 Form C contact type 5A26458G02 Kit - 1 Form X contact type 5A26458G03 Kit - Project specific
Relay contact ratings	Form C relays: 10 amps @240 VAC, PF=0.8 3 amps @150 VDC Form X relays: 10 amps @240 VAC, PF=0.8 10 amps @150 VDC
Typical propagation time	Operate time: 15 mSec, excluding bounce Release time: 10 mSec, excluding bounce
Dielectric isolation: Relay contacts to logic	 2200V AC/DC
Relay base power	Auxiliary power: 23.45 W typical, 30.1 W maximum (5A26458G01 Kit - Form C relays) 15.9 W typical, 20.41 W maximum (5A26458G02 Kit - Form X relays)
Auxiliary power supply [1]	25V typical (before output auctioneering diode drop within Ovation auxiliary power supply) 25.5V maximum @42°C (108°F) (Form C relays) 25.5V maximum @60°C (140°F) (Form X relays)
Operating temperature range [2]	0 to 45°C (32°F to 113°F) (5A26458G01 Kit - Form C relays) 0 to 60°C (32°F to 140°F) (5A26458G02 Kit - Form X relays)
Storage temperature range	KUEP X: -40 to 70°C (-40°F to 158°F) KUEP C: -40 to 50°C (-40°F to 122°F)
[1] Use of internal Ovation auxiliary power supply is recommended for Relay Output modules. [2] See additional application derating information contained in Using Relay Output Bases (see page 294).	

SECTION 21

RTD MODULE (4 CHANNEL)

IN THIS SECTION

Description *305*
Module Group Information *305*
Wiring Information *306*
Address Location Information *311*
Diagnostic LEDs *313*
Specifications *313*

21.1 DESCRIPTION

The RTD module is used to convert inputs from Resistance Temperature Detectors (RTDs) to digital data. The digitized data is transmitted to the Controller.

The RTD Module is applicable for CE Mark Certified Systems.

Note: *I/O Module General Information (see page 15) contains environmental, installation, wiring, and fuse information for I/O modules.*

21.2 MODULE GROUP INFORMATION

21.2.1 ELECTRONICS MODULES (EMODS)

There are two Electronics module groups for the RTD Module:

- **1C31161G01** converts inputs for all ranges and is compatible only with Personality module 1C31164G01 (not applicable for CE Mark certified systems).
- **1C31161G02** converts inputs for all ranges and is compatible with Personality module 1C31164G02 (applicable for CE Mark certified systems).

21.2.2 PERSONALITY MODULES (PMODS)

There are two Personality module groups for the RTD Module:

- **1C31164G01** converts inputs for all ranges and is compatible only with Electronics module 1C31161G01 (not for new systems and is not applicable for CE Mark certified systems).
- **1C31164G02 (50/60 Hz filtered)** converts inputs for all ranges and is only compatible with Electronics module 1C31161G02 (applicable for CE Mark certified systems).

21.2.3 SUBSYSTEMS, RTD MODULE

RTD Module Subsystems

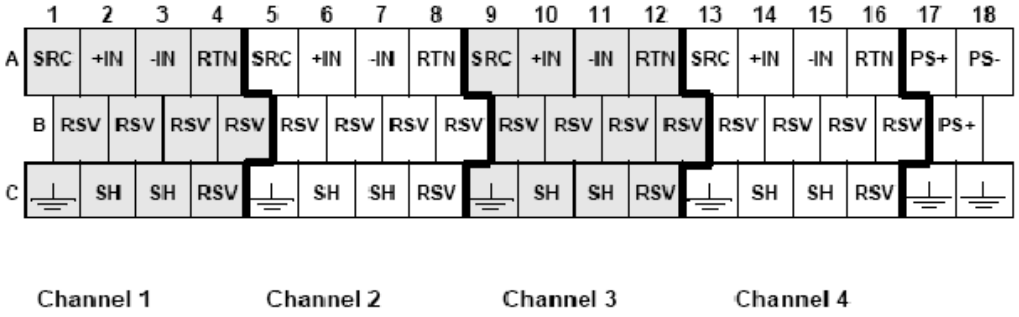
RANGE	CHANNELS	ELECTRONIC MODULE	PERSONALITY MODULE
All	4	1C31161G01	1C31164G01
All (for 50/60 Hz filtered inputs and CE Mark certified systems)	4	1C31161G02 [1]	1C31164G02 [1]
[1] Only configuration 1C3116G02 / 1C31164G02 is CE Mark certified.			

21.3 WIRING INFORMATION

21.3.1 RTD (4 CHANNEL) SYSTEMS (USING PMOD 1C31164G0) TERMINAL BLOCK WIRING INFORMATION

Each Personality module has a simplified wiring diagram label on its side, which appears above the terminal block. The following diagram indicates how the wiring from the field is to be connected to the terminal block in the base unit.

(1C31164G01)


1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18
A SRC +IN -IN RTN SRC +IN -IN RTN SRC +IN -IN RTN SRC +IN -IN RTN PS+ PS-
B RSV RSV RSV RSV RSV RSV RSV RSV RSV RSV RSV RSV RSV RSV RSV RSV RSV PS+
C SH SH RSV SH SH RSV SH SH RSV SH SH RSV SH SH RSV
Channel 1
Channel 2
Channel 3
Channel 4

The following table lists and defines the abbreviations used in this diagram.

ABBREVIATION	DEFINITION
+IN, -IN	Positive and negative sense input connection
	Earth ground terminal
PS+, PS-	Auxiliary power supply terminals
RTN	Return for current source connection
SH	Shield connector
SRC	Current source connection
RSV	Reserved terminal. No connections allowed on these terminals.

Note: *Do **not** use unmarked terminal block locations.*
PS+ and PS- are not used by this module.

21.3.2 RTD (4 CHANNEL) SYSTEMS (USING PMOD 1C31164G02) TERMINAL BLOCK WIRING INFORMATION

Each Personality module has a simplified wiring diagram label on its side, which appears above the terminal block. This diagram indicates how the wiring from the field is to be connected to the terminal block in the base unit. The diagram for the RTD Personality module.

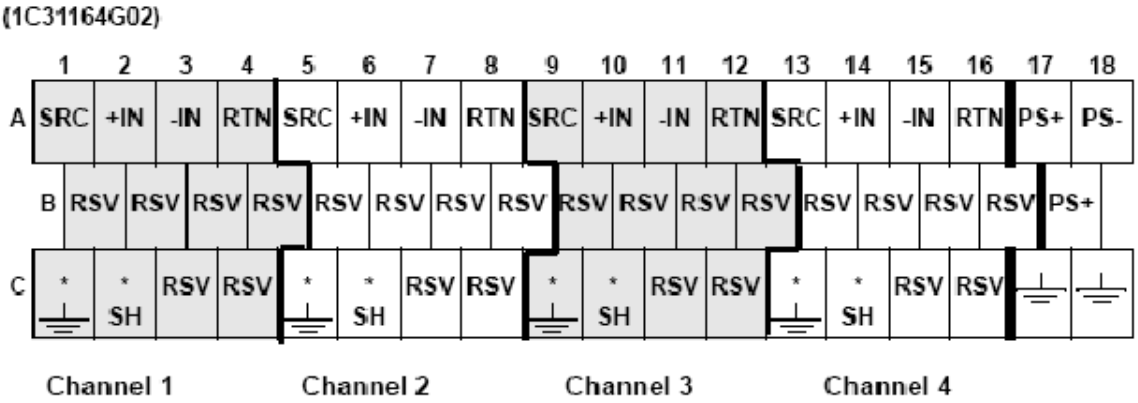
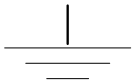

(1C31164G02)
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18
A SRC +IN -IN RTN SRC +IN -IN RTN SRC +IN -IN RTN SRC +IN -IN RTN PS+ PS-
B RSV RSV RSV RSV RSV RSV RSV RSV RSV RSV RSV RSV RSV RSV RSV RSV PS+
C * * SH RSV RSV * * SH RSV RSV * * SH RSV RSV * * SH RSV RSV
Channel 1
Channel 2
Channel 3
Channel 4

Figure 126: Terminal Block Connections for the RTD Pmod (1C31164G02)

The following table lists and defines the abbreviations used in this diagram.

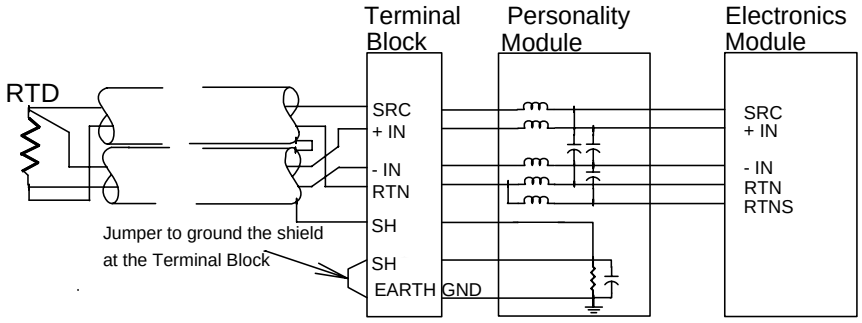
Abbreviations Used in Diagrams

ABBREVIATION	DEFINITION
+IN, -IN	Positive and negative sense input connection
	Earth ground terminal
PS+, PS-	Auxiliary power supply terminals
RTN	Return for current source connection
SH	Shield connector
SRC	Current source connection
RSV	Reserved terminal. No connections allowed on these terminals.

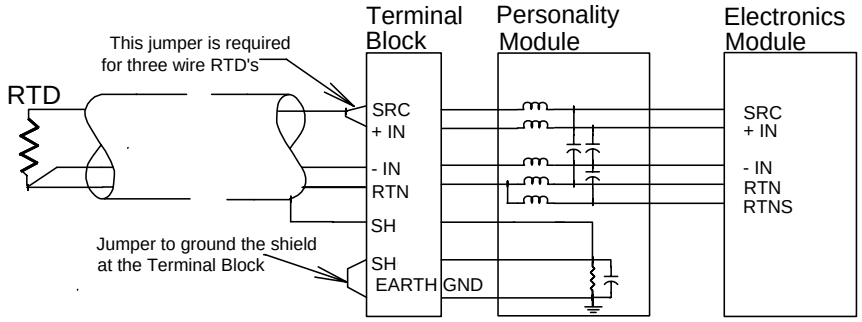
Note: *Do **not** use unmarked terminal block locations.*

PS+ and PS- are not used by this module.

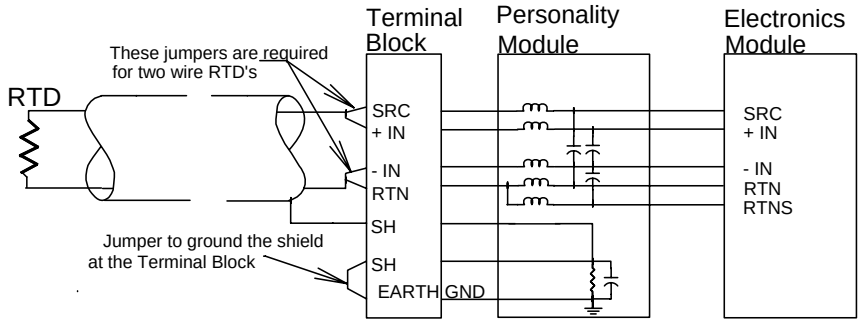
21.3.3 SYSTEMS USING PERSONALITY MODULE 1C31164G01



Input Field Wiring for Four Wire RTD's



Input Field Wiring for Three Wire RTD's



Input Field Wiring for Two Wire RTD's

Figure 127: Field Connection for the RTD Pmod 1C31164G01 (Non-CE Mark)

21.3.4 NON-CE MARK SYSTEMS USING PERSONALITY MODULE 1C31164G02

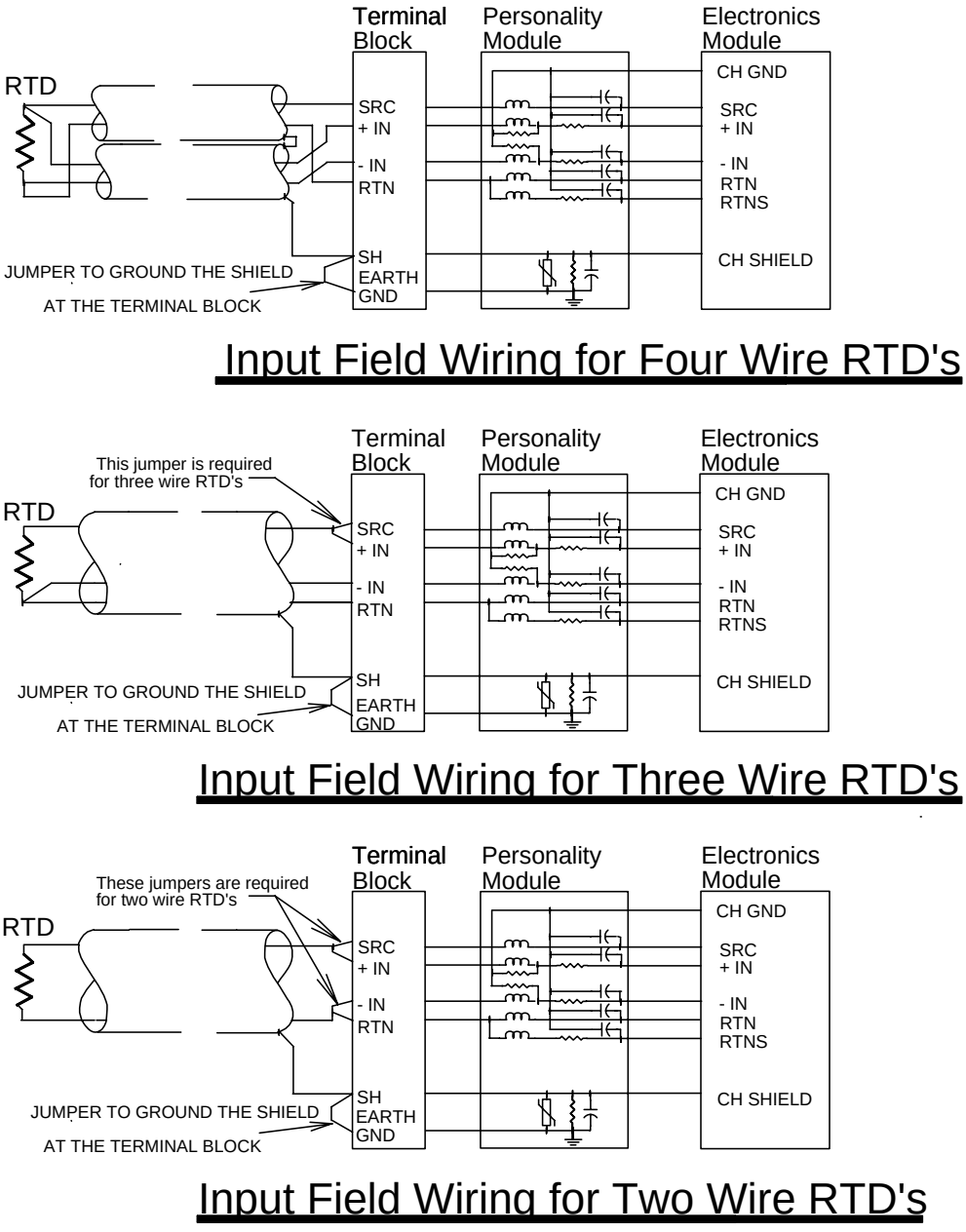
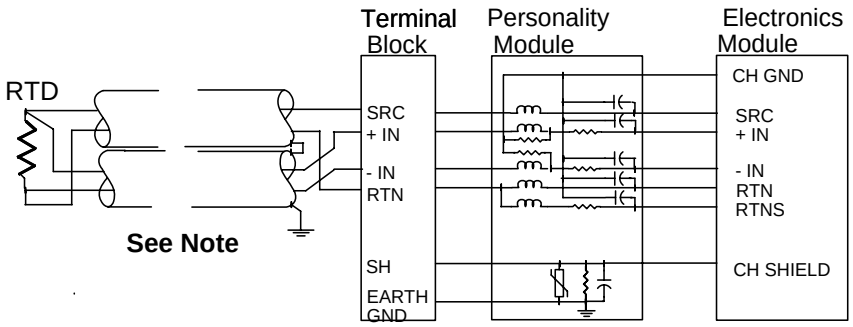
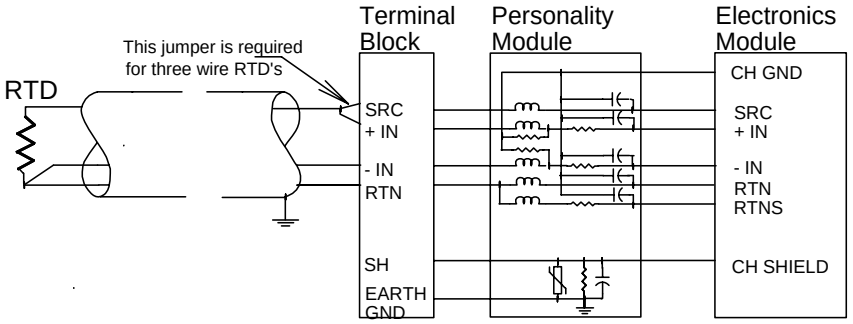


Figure 128: Field Connection for the RTD Personality Module (Non-CE Mark)

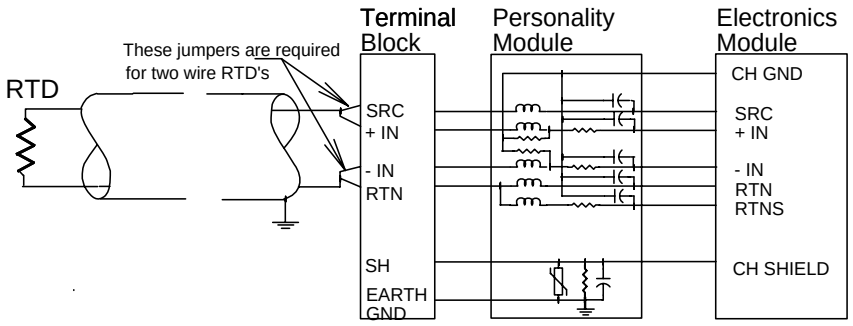
21.3.5 CE MARK CERTIFIED SYSTEMS USING PERSONALITY MODULE 1C31164G02



Input Field Wiring for Four Wire RTD's



Input Field Wiring for Three Wire RTD's



Input Field Wiring for Two Wire RTD's

Note

All field wiring must be braid-shielded and grounded at the entry point of the cabinet using the recommended hardware (refer to "Cable Guidelines" in the appropriate "*Planning Your Ovation System*" manual).

Figure 129: Field Connection for the RTD Personality Module (CE Mark)

21.4 Address Location Information

21.4.1 Configuration and Status Register

Word address 13 (D in Hex) is used to configure the module and provide status information to the Controller.

Word address 13 (D in Hex) low byte is used for module configuration.

Word address 13 (D in Hex) high byte is used to define the scale for Channel 2.

The status register can be read by using the Point Information window at an Operator Station (see the Bit Pattern field on the Hardware tab). (See *Ovation Operator Station User Guide.)*

RTD Configuration/Status Register (Address 13 or D in Hex)

Bit	Data Description - Configuration Register (Write)	Data Description - Status Register (Read)
0	Configure Module	Module Configured (1 = configured; 0 = un-considered)
1	Force error	Internal or forced error (1 = forced error; 0 = no forced error)
2	Not used	Point Fault bit (set when any point specific fault exists)
3	Not used	Card trouble bit (set during card failure)
4	Not used	Warming bit (set during power up or configuration)
5	50/60 Hz select (0 = 60Hz, 1 = 50Hz)	50/60 Hz select readback (0 = 60Hz, 1 = 50Hz)
6	Enable line frequency tracking.	Status of the line frequency tracking enable signal.
7	Diagnostic bit (do not use). When set in the “Diagnostics” mode, Bits 0 to 6 of the configuration register represent a word address of the Micro Controller’s internal memory.	Sync Fault (set if SYNC is missing or the reasonability test failed while the line frequency tracking is enabled)
8 - 15	Channel #2 scale configuration	Channel #2 scale configuration read back

Note: *Line frequency tracking is presently NOT supported by the Ovation I/O system.*

Expansion Configuration and Status Register 1

Word address 14 (E in Hex) is used to define the scales for Channels 3 and 4.

Expansion Configuration and Status Register (Address 14 or E in Hex)

BIT	DATA DESCRIPTION - CONFIGURATION (WRITE)	DATA DESCRIPTION - STATUS (READ)
0 - 7	Channel 3 scale configuration	Channel 3 scale configuration read back
8 - 15	Channel 4 scale configuration	Channel 4 scale configuration read back

Point Status Register (Read)

Word address 12 (C in Hex) low byte is used for point status.

Word address 12 (C in Hex) high byte is used during write to define the scales for Channels 3 and 4.

The bit definitions for this register during read are encoded.

Point Status Register (Address 12 or C in Hex)

BIT	DATA DESCRIPTION - CONFIGURATION (WRITE)	DATA DESCRIPTION - STATUS (READ)
0	Reserved for Point Status	Channel 1, reasonability test failed (Zero or Common mode)
1	Reserved for Point Status	Channel 1, current loop reasonability test failed
2	Reserved for Point Status	Channel 2, reasonability test failed (Zero or Common mode)
3	Reserved for Point Status	Channel 2, current loop reasonability test failed
4	Reserved for Point Status	Channel 3, reasonability test failed (Zero or Common mode)
5	Reserved for Point Status	Channel 3, current loop reasonability test failed
6	Reserved for Point Status	Channel 4, reasonability test failed (Zero or Common mode)
7	Reserved for Point Status	Channel 4, current loop reasonability test failed
8 - 15	Configure Channel 1 scales	Channel 1, scale configuration read back

Note: Status bits when set (1) indicate the fault condition.

21.5 DIAGNOSTIC LEDS

The following table lists the module's LEDs and describes what they mean when lit.

RTD Diagnostic LEDs

LED	DESCRIPTION
P (Green)	Power OK LED. Lit when the +5V power is OK.
C (Green)	Communications OK LED. Lit when the Controller is communicating with the module.
I (Red)	Internal Fault LED. Lit whenever the Force Error bit (Bit 1) of the Configuration Register (see page 312) is set, or when a timeout of the watchdog timer occurs when the Controller stops communicating with the module. Also lit when the IMOK signal is false (0) indicating failures of part or all of the logic common to the input channels.
CH1 (Red)	Channel error. Lit whenever there is an error associated with Channel 1.
CH2 (Red)	Channel error. Lit whenever there is an error associated with Channel 2.
CH3 (Red)	Channel error. Lit whenever there is an error associated with Channel 3.
CH4 (Red)	Channel error. Lit whenever there is an error associated with Channel 4.

21.6 SPECIFICATIONS

Electronics Module (1C31161)

Personality Module (1C31164)

RTD Module Specifications

DESCRIPTION	VALUE
Number of channels	4
Sampling rate	Four per second (two per second during auto calibration)
RTD ranges	Refer to the following RTD Ranges table.
Resolution	12 bits
Guaranteed accuracy (@25°C)	0.10% ± [0.045 (Rcold/Rspan)]% ± [((Rcold + Rspan)/4096 OHM)]% ± [0.5 OHM/Rspan]% ±10 μV ± 1/2LSB where: Rcold and Rspan are in Ohms.
Temperature coefficient	10ppm/°C

DESCRIPTION	VALUE
Dielectric isolation:	
Channel to channel	1000 V AC/DC
Channel to logic	1000 V AC/DC
Input impedance	100 M OHM 1 M OHM in power down (for input voltages 0 to 0.1 V)
Module power	3.6 W typical; 4.2 W maximum
Operating temperature range	0 to 60°C (32°F to 140°F)
Storage temperature range	-40°C to 85°C (-40°F to 185°F)
Humidity (non-condensing)	0 to 95%

21.6.1 RTD RANGES

RTD Ranges

SCALE # HEX	WIRES	TYPE	TEMP oF	TEMP oC	RCOLD (OHM)	RHOT (OHM)	EXCITATION CURRENT (MA)	ACCURACY ± COUNTS	ACCURACY±% OF SPAN
1	3	10 Ohm PL	0 to 1200	–18 to 649	6	106.3	0.1556	9	0.22
2	3	10 Ohm CU	0 to 302	–18 to 150	8.5	16.5	1.51	13	0.32
D	3	10 Ohm CU	32 to 284	0 to 140	50	80	1.0756	11	0.27
11	3	10 Ohm CU	32 to 230	0 to 110	53	78	1.1291	12	0.30
19	3	100 Ohm PL	–4 to 334	–20 to 168	92	163.67	0.5121	11	0.27
22	3	100 Ohm PL	32 to 520	0 to 271	100	200	0.4087	10	0.25
23	3	100 Ohm PL	32 to 1040	0 to 560	100	301	0.2554	10	0.25
25	3	120 Ohm NI	–12 to 464	–11 to 240	109	360	0.2104	10	0.25

SCALE # HEX	WIRES	TYPE	TEMP oF	TEMP oC	RCOLD (OHM)	RHOT (OHM)	EXCITATION CURRENT (MA)	ACCURACY ± COUNTS	ACCURACY±% OF SPAN
26	3	120 Ohm NI	32 to 150	0 to 66	120	170	0.5240	13	0.32
28	3	120 Ohm NI	32 to 252	0 to 122	120	225	0.3682	11	0.27
80	4	100 Ohm PL	32 to 544	0 to 290	100	208	0.3921	10	0.25
81	4	100 Ohm PL	356 to 446	180 to 230	168	186	0.5240	30	0.74
82	4	200 Ohm PL	32 to 698	0 to 370	200	473	0.1675	12	0.30
83	4	200 Ohm PL	514 to 648	268 to 342	402	452	0.2142	29	0.71
84	4	100 Ohm PL	32 to 124	0 to 51	100	120	0.7860	19	0.47
85	4	100 Ohm PL	32 to 217	0 to 103	100	140	0.6386	13	0.32
86	4	100 Ohm PL	32 to 412	0 to 211	100	180	0.4644	11	0.27
87	4	100 Ohm PL	32 to 714	0 to 379	100	240	0.3296	10	0.25
88	4	200 Ohm PL	511 to 662	266 to 350	200	230	0.4170	24	0.59

SECTION 22

RTD MODULE (8 CHANNEL)

IN THIS SECTION

Description *317*
Module Group Information *318*
Wiring Information *318*
Address Location Information *322*
Diagnostic LEDs *325*
Specifications *325*

22.1 DESCRIPTION

The 8-channel RTD module is used to convert inputs from Resistance Temperature Detectors (RTDs) to digital data. The digitized data is transmitted to the Controller.

Note: *I/O Module General Information (see page 15) contains environmental, installation, wiring, and fuse information for I/O modules.*

CAUTION! The following applies to channels that are subsequently wired to an RTD after power is applied to the module.

If an RTD is wired into a live eight channel RTD module, one of the following two conditions must be met to insure reading of the RTD:

1. Module power must be cycled *after* the RTD is installed.

2. The particular point to which the RTD is installed must be configured or re-configured after the RTD is installed.

Please note that there are no considerations necessary if the RTD is installed prior to power being applied to the module. Further, once the conditions for proper operations are met, the RTD can be removed and subsequently re-installed at which time it will be read correctly without any further considerations.

22.2 Module Group Information

22.2.1 Electronics Module (Emod)

There is one Electronics module group for the 8-channel RTD Module:

- **5X00119G01** converts inputs for all ranges and is compatible only with Personality module 5X00121G01.

22.2.2 Personality Module (Pmod)

There is one Personality module group for the 8-channel RTD Module:

- **5X00121G01** converts inputs for all ranges and is compatible only with Electronics module 5X00119G01.

22.2.3 Subsystems, 8-Channel RTD Module

8-Channel RTD Module Subsystems

Channels	Electronic Module	Personality Module
8	5X00119G01	5X00121G01

22.3 Wiring Information

22.3.1 RTD (8 Channel) Systems (Using Pmod 5X00121G01) Terminal Block Wiring Information

Each Personality module has a simplified wiring diagram label on its side, which appears above the terminal block. This diagram indicates how the wiring from the field is to be connected to the terminal block in the base unit. The following table lists and defines the abbreviations used in this diagram.

Abbreviations Used in the Diagram

Abbreviation	Definition
+IN, -IN	Positive and negative sense input connection.
	Earth ground terminal. Used for landing shields when the shield is to be grounded at the module.
PS+, PS-	Auxiliary power supply terminals.
RTN	Return for current source connection.
SH	Shield connector. Used for landing shields when the shield is to be grounded at the RTD.
SRC	Current source connection.

Note: *PS+ and PS- are not used by this module.*

22.3.2 MODULE AND FIELD CONNECTION WIRING

The Ovation 8-Channel RTD module consists of two modules, an electronics module containing a logic printed circuit board (LIA) and a printed circuit board (FTD). The electronics module is used in conjunction with a personality module, which contains a single printed circuit board (PTD). The block diagram for the 8-channel RTD module is shown below.

Module Block Diagram and Field Connection Wiring Diagram

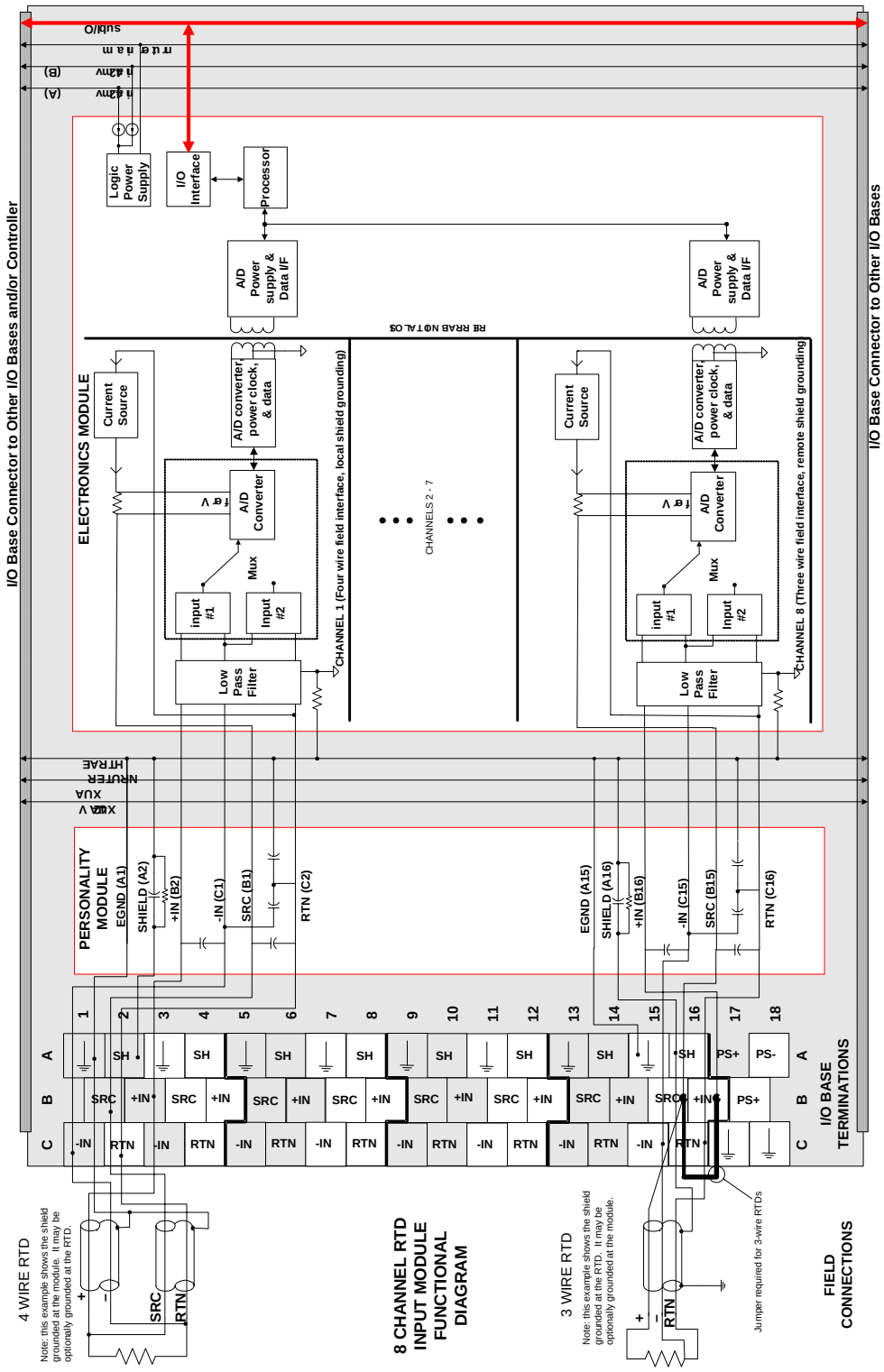


Figure 130: 8-Channel RTD Block Diagram and Field Connection Wiring Diagram

22.4 Address Location Information

22.4.1 Configuration and Status Register

Word address 13 (D in Hex) is used to configure the module and provide status information to the Controller. The status register can be read by using the Point Information window at an Operator Station (Bit Pattern Field on the Hardware Tab). (See the *Ovation Operator Station User Guide*.)

8-Channel RTD Configuration/Status Register (Address 13 or D in Hex)

Bit	Data Description - Configuration Register (Write)	Data Description - Status Register (Read)
0	Configure Module	Module Configured (1 = configured; 0 = unconfigured)
1	Force error	Internal or forced error (1 = forced error; 0 = no forced error)
2	50/60 Hz select (0 = 60Hz, 1 = 50Hz)	50/60 Hz System (1 = 50Hz) (read back)
3	SELF_CAL (Initiates Self Calibration)	Warming bit (set during power up or configuration)
4	0	0
5	0	0
6	0	Module Not Calibrated
7	0	0
8	Channel 1 _ 3/4 Wire	Channel 1 _ 3/4 Wire - Configuration (read back)
9	Channel 2 _ 3/4 Wire	Channel 2 _ 3/4 Wire - Configuration (read back)
10	Channel 3 _ 3/4 Wire	Channel 3 _ 3/4 Wire - Configuration (read back)
11	Channel 4 _ 3/4 Wire	Channel 4 _ 3/4 Wire - Configuration (read back)
12	Channel 5 _ 3/4 Wire	Channel 5 _ 3/4 Wire - Configuration (read back)
13	Channel 6 _ 3/4 Wire	Channel 6 _ 3/4 Wire - Configuration (read back)
14	Channel 7 _ 3/4 Wire	Channel 7 _ 3/4 Wire - Configuration (read back)
15	Channel 8 _ 3/4 Wire	Channel 8 _ 3/4 Wire - Configuration (read back)

Definitions for the Configuration/Module Status Register bits:

Bit 0: This bit configures the module (write) or indicates the configuration state of the module (read). A “1” indicates that the module is configured. Note that until the module is configured, reading from addresses 0 through 11 (B in Hex) will produce an attention status.

Bit 1: This bit (write “1”) forces the module into the error state, resulting in the error LED being lit. The read of bit “1” indicates that there is an internal module error, or the controller has forced the module into the error state. The state of this bit is always reflected by the module’s Internal Error LED. Whenever this bit is set, an attention status is returned to the controller when address 0 through 11 (B in Hex) are read.

Bit 2: The status of this bit (read) indicates the conversion rate of the module, write to this bit configures the conversion rate of A/D converters as shown below.

CONVERSION RATE (1/SEC.)	BIT 2
60 (for 60Hz systems)	0
50 (for 50Hz systems)	1

Bit3: Write: This bit is used to initiate self-calibration. Read: This bit indicates that the module is in the "Warming" state. This state exists after power up and terminates after 8.16 seconds. The module will be in the error condition during the warm up period.

Bits 4 - 5: These bits are not used and read as "0" under normal operation.

Bit 6: This bit (read) is the result of a checksum test of the EEPROM. A failure of this test can indicate a bad EEPROM, but it typically indicates that the module has not been calibrated. A "0" indicates that there is no error condition. If an error is present, the internal error LED is lit and attention status will be returned for all address offsets 0-11 (0x0 - 0xB). The "1" state of this bit indicates an unrecoverable error condition in the field.

Bit 7: This bit is not used and read as "0" under normal operation.

Bits 8 - 15: These bits are used to configure channels 1 - 8 respectively for 3 or 4 wire operation. A "0" indicates 3 wire and a "1" indicates 4 wire operation, see the tables below).

22.4.2 CHANNEL SCALE CONFIGURATION REGISTERS

Word addresses 12 and 14 (described in the following two tables) are used to configure the appropriate scales for Channels 1 - 8 (refer to Column 1 in the table in Specifications (see page 325)).

Data Format for the Channel Scale Configuration Register (Address 12 or C in Hex)

BIT	DATA DESCRIPTION - CONFIGURATION (WRITE)	DATA DESCRIPTION - STATUS (READ)
0	Configure Channel #1scale - Bit 0	Channel #1 scale configuration (read back) - Bit 0
1	Configure Channel #1scale - Bit 1	Channel #1 scale configuration (read back) - Bit 1
2	Configure Channel #1scale - Bit 2	Channel #1 scale configuration (read back) - Bit 2
3	Configure Channel #1scale - Bit 3	Channel #1 scale configuration (read back) - Bit 3
4	Configure Channel #2 scale - Bit 0	Channel #2 scale configuration (read back) - Bit 0
5	Configure Channel #2 scale - Bit 1	Channel #2 scale configuration (read back) - Bit 1
6	Configure Channel #2 scale - Bit 2	Channel #2 scale configuration (read back) - Bit 2
7	Configure Channel #2 scale - Bit 3	Channel #2 scale configuration (read back) - Bit 3
8	Configure Channel #3 scale - Bit 0	Channel #3 scale configuration (read back) - Bit 0
9	Configure Channel #3 scale - Bit 1	Channel #3 scale configuration (read back) - Bit 1
10	Configure Channel #3 scale - Bit 2	Channel #3 scale configuration (read back) - Bit 2
11	Configure Channel #3 scale - Bit 3	Channel #3 scale configuration (read back) - Bit 3

BIT	DATA DESCRIPTION - CONFIGURATION (WRITE)	DATA DESCRIPTION - STATUS (READ)
12	Configure Channel #4 scale - Bit 0	Channel #4 scale configuration (read back) - Bit 0
13	Configure Channel #4 scale - Bit 1	Channel #4 scale configuration (read back) - Bit 1
14	Configure Channel #4 scale - Bit 2	Channel #4 scale configuration (read back) - Bit 2
15	Configure Channel #4 scale - Bit 3	Channel #4 scale configuration (read back) - Bit 3

CAUTION! Configuring any or all channel scales while the system is running will cause all channels to return attention status for up to two seconds following the reconfiguration.

Data Format for the Channel Scale Configuration Register (Address 14 or E in Hex)

BIT	DATA DESCRIPTION - CONFIGURATION (WRITE)	DATA DESCRIPTION - STATUS (READ)
0	Configure Channel #5 scale - Bit 0	Channel #5 scale configuration (read back) - Bit 0
1	Configure Channel #5 scale - Bit 1	Channel #5 scale configuration (read back) - Bit 1
2	Configure Channel #5 scale - Bit 2	Channel #5 scale configuration (read back) - Bit 2
3	Configure Channel #5 scale - Bit 3	Channel #5 scale configuration (read back) - Bit 3
4	Configure Channel #6 scale - Bit 0	Channel #6 scale configuration (read back) - Bit 0
5	Configure Channel #6 scale - Bit 1	Channel #6 scale configuration (read back) - Bit 1
6	Configure Channel #6 scale - Bit 2	Channel #6 scale configuration (read back) - Bit 2
7	Configure Channel #6 scale - Bit 3	Channel #6 scale configuration (read back) - Bit 3
8	Configure Channel #7 scale - Bit 0	Channel #7 scale configuration (read back) - Bit 0
9	Configure Channel #7 scale - Bit 1	Channel #7 scale configuration (read back) - Bit 1
10	Configure Channel #7 scale - Bit 2	Channel #7 scale configuration (read back) - Bit 2
11	Configure Channel #7 scale - Bit 3	Channel #7 scale configuration (read back) - Bit 3
12	Configure Channel #8 scale - Bit 0	Channel #8 scale configuration (read back) - Bit 0
13	Configure Channel #8 scale - Bit 1	Channel #8 scale configuration (read back) - Bit 1
14	Configure Channel #8 scale - Bit 2	Channel #8 scale configuration (read back) - Bit 2
15	Configure Channel #8 scale - Bit 3	Channel #8 scale configuration (read back) - Bit 3

CAUTION! Configuring any or all channel scales while the system is running will cause all channels to return attention status for up to two seconds following the reconfiguration.

22.5 DIAGNOSTIC LEDS

The following table lists the module's LEDs and describes what they mean when lit.

8-Channel RTD Diagnostic LEDs

LED	DESCRIPTION
P (Green)	Power OK LED. Lit when the +5V power is OK.
C (Green)	Communications OK LED. Lit when the Controller is communicating with the module.
I (Red)	Internal Fault LED. Lit whenever there is any type of error with the module **except** to a loss of power. Possible causes are: ▪ Module initialization is in progress. ▪ I/O Bus time-out has occurred. ▪ Register, static RAM, or FLASH checksum error. ▪ Module reset. ▪ Module is uncalibrated. ▪ Forced error has been received from the Controller. ▪ Communication between the Field and Logic boards failed.
CH1 - CH 8 (Red)	Channel error. Lit whenever there is an error associated with a channel or channels. Possible causes are: ▪ Positive overrange. ▪ Negative overrange. ▪ Communication with the channel has failed.

22.6 SPECIFICATIONS

Electronics Module (5X00119)

Personality Module (5X00121)

8-Channel RTD Module Specifications

DESCRIPTION	VALUE
Number of channels	8
Sampling rate	50 HZ mode: 16.67/sec. normally. In 3 wire mode, lead resistance measurement occurs once every 6.45 sec. during which the rate drops to 3/sec. 60 HZ mode: 20/sec. normally. In 3 wire mode, lead resistance measurement occurs once every 6.45 sec. during which the rate drops to 2/sec. Self Calibration Mode: Occurs on demand only. The rate drops to 1/sec. once during each self calibration cycle.
RTD ranges	Refer to the following RTD Ranges table.
Resolution	12 bits

DESCRIPTION	VALUE
Guaranteed accuracy (@25×C)	0.10% ± [0.045 (Rcold/Rspan)]% ± [((Rcold + Rspan)/4096 OHM)]% ± [0.5 OHM/Rspan]% ±10 mV ± 1/2LSB where: Rcold and Rspan are in Ohms.
Temperature coefficient	10ppm/ oC
Dielectric isolation: Channel to channel Channel to logic	 200V AC/DC 1000 V AC/DC
Input impedance	100 M OHM 50 K OHM in power down
Module power	3.6 W typical; 4.2 W maximum
Operating temperature range	0 to 60oC (32oF to 140oF)
Storage temperature range	-40oC to 85oC (-40oF to 185oF)
Humidity (non-condensing)	0 to 95%
Self Calibration	On Demand by Ovation Controller
Common Mode Rejection	120 dB @ DC and nominal power line frequency +/- 1/2%
Normal Mode Rejection	100 dB @ DC and nominal power line frequency +/- 1/2%

22.6.1 8-CHANNEL RTD RANGES

8-Channel RTD Ranges

SCALE # (HEX) [1]	SCALE # HEX) [2]	WIRES	TYPE	TEMP oF	TEMP oC	RCOLD (OHM)	RHOT (OHM)	EXCITATION CURRENT (MA)	ACCURACY COUNTS	ACCURACY% OF SPAN
0	0	3	10 Ohm PL	0 to 1200	–18 to 649	6	106.3	1.0	9	0.22
1	1	3	10 Ohm CU	0 to 302	–18 to 150	8.5	16.5	1.0	13	0.32
2	2	3	10 Ohm CU	32 to 284	0 to 140	50	80	1.0	11	0.27
3	3	3	10 Ohm CU	32 to 230	0 to 110	53	78	1.0	12	0.30

4	4	3	100 Ohm PL	–4 to 334	–20 to 168	92	163.67	1.0	11	0.27
5	5	3	100 Ohm PL	32 to 520	0 to 271	100	200	1.0	10	0.25
6	6	3	100 Ohm PL	32 to 1040	0 to 560	100	301	1.0	10	0.25
7	7	3	120 Ohm NI	–12 to 464	–11 to 240	109	360	1.0	10	0.25
8	8	3	120 Ohm NI	32 to 150	0 to 66	120	170	1.0	13	0.32
9	9	3	120 Ohm NI	32 to 252	0 to 122	120	225	1.0	11	0.27
0	10	4	100 Ohm PL	32 to 544	0 to 290	100	208	1.0	10	0.25
1	11	4	100 Ohm PL	356 to 446	180 to 230	168	186	1.0	30	0.74
2	12	4	200 Ohm PL	32 to 698	0 to 370	200	473	1.0	12	0.30
3	13	4	200 Ohm PL	514 to 648	268 to 342	402	452	1.0	29	0.71
4	14	4	100 Ohm PL	32 to 124	0 to 51	100	120	1.0	19	0.47
5	15	4	100 Ohm PL	32 to 217	0 to 103	100	140	1.0	13	0.32
6	16	4	100 Ohm PL	32 to 412	0 to 211	100	180	1.0	11	0.27
7	17	4	100 Ohm PL	32 to 714	0 to 379	100	240	1.0	10	0.25
8	18	4	200 Ohm PL	511 to 662	266 to 350	200	230	1.0	24	0.59

[1] For Hardware configuration.

[2] For Software Purposes. This value is used in Import/Export files.

SECTION 23

SEQUENCE OF EVENTS MODULE

IN THIS SECTION

Description *330*
Module Group Information *331*
Module Specific Information *331*
Wiring Information, Sequence of Events Modules *332*
Address Location Information *347*
Diagnostic LEDs *348*
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23.1 DESCRIPTION

The Sequence of Events (SOE) module provides 16 digital channels to monitor the open or closed state of digital inputs or contacts in the field. The module provides a filter to reject changes of state less than four milliseconds. The Sequence of Events module can also perform event tagging and chatter control for each input channel.

The Ovation Controller writes a channel event tagging mask to the Electronics module to enable event tagging for specific input channels. It has a chatter control flag for each channel to indicate that an input channel has changed state too many times in a period of time or is changing state at too fast a rate. It also has a channel ID to indicate which channel changed state.

Each channel is checked every 125 microseconds. If the channel event tagging mask bit is zero, that channel is not checked. Time synchronization is accomplished by the Ovation Controller writing a time reference simultaneously to all Sequence of Events modules with a 1 millisecond resolution.

Note: *I/O Module General Information (see page 15) contains environmental, installation, wiring, and fuse information for I/O modules. All SOE modules in a Controller MUST be connected to the IOIC card that is configured as the Time Keeper.*

A control bit written by the Ovation Controller provides two options for handling input chatter:

- The first option will set the chatter control flag if the rate of change for an input is greater than 1 per 100 milliseconds.
- The second option sets the chatter control flag if 4 or more state changes occur on an input between reads of the event buffer.

There are two 32 event buffers. This allows the event tagging and chatter control function to be writing into one event buffer while the Ovation Controller is reading the other event buffer. The Ovation Controller only reads each module a small portion of the loop time. This allows both event buffers to be available the rest of the loop time.

Each event buffer contains 64 words with up to 32 Channel-IDs and 32 Event-Times. The event buffers are memories. The memory control circuit controls which event buffer to write into and which event buffer to read from. Before reading the event buffer, the buffer status register must be read to determine the number of words to read.

The Sequence of Events Module is applicable for CE Mark Certified Systems.

CAUTION! (For CE Mark certified systems) Any base unit that contains a 125VDC Sequence of Events Electronics module (1C31157G02) with differential Digital Input Personality module (1C31110G02) and interfaces to hazardous voltage (>60 VDC) must include a hazardous voltage warning label (1B30025H01) on that base unit.

Any base unit that contains a 125VDC Sequence of Events Electronics module (1C31157G02) with single-ended Digital Input Personality module (1C31110G01) and interfaces to hazardous voltage (>60 VDC) must include a hazardous voltage warning label (1B30025H01) on ALL base units on the branch.

This label must be placed in a visible location on the base unit, preferably above the spare fuse location. The project drawings must indicate this.

23.2 Module Group Information

23.2.1 Electronics Modules (Emods)

There are three Electronics module groups for the Sequence of Events Module:

- **1C31157G01** provides for 24/48 VDC single-ended or differential inputs.
- **1C31157G02** provides for 125 VDC single-ended or differential inputs.
- **1C31157G03** (Contact Input) provides for 48 VDC on-card auxiliary power.

23.2.2 Personality Modules (Pmods)

There are three Personality module groups for the Sequence of Events Module:

- **1C31110G01** (single-ended inputs) and **1C31110G02** (differential input) are used for digital input (see page 332).
- **1C31110G03** is used for contact input (see page 340).

23.2.3 Subsystems, Sequence of Events

Sequence of Events Subsystems

Range	Channels	Electronic Module	Personality Module
24/48 VDC			
Single-ended	16	1C31157G01	1C31110G01
Differential	16	1C31157G01	1C31110G02
125 VDC			
Single-ended	16	1C31157G02	1C31110G01
Differential	16	1C31157G02	1C31110G02
Contact Input w/ 48 VDC On-Card auxiliary	16	1C31157G03	1C31110G03

All configurations are CE Mark certified except those containing Emod 1C311577 with a 5FDI.

When the 125VAC/VDC Sequence of Events Digital Input Emod (1C31157G02) is used in applications without the Fused Pmod (5X00034G01), additional external fusing or other current limiting devices are recommended on the hazardous inputs to provide additional protection to the external wiring and power source.

23.3 Module Specific Information

23.3.1 External Power Supplies

If the Sequence of Events Digital Input module uses the 1C31110G01 Personality module (configured for 16 single-ended inputs), the required voltage source may be obtained from the internal auxiliary power supply (backplane) or it may be obtained from an external power supply.

If an external power supply is used, Using an External Power Supply (see page 539) contains steps to be undertaken before connecting the external power supply to the Sequence of Events Digital Input module base unit terminal block.

23.4 Wiring Information, Sequence of Events Modules

The Sequence of Events modules can be divided into two types depending on their front end connections, Digital Input Field Interface or Contact Filed Interface. The digital Input field Interface modules can be broken down further into Single-Ended and Differential as well as low and high voltage.

The following wiring section topics will be split to show the wiring of the Sequence of Events Digital Input Field Interface modules, then the Sequence of Events Contact Filed Interface modules.

23.4.1 Sequence of Events Digital Input Field Interface Modules

Digital Input Field Interface

The Digital Input configuration contains 16 channels, where each channel has voltage level sensing circuitry used to detect whether an input is on or off. The Sequence of Events module has 16 isolated differential inputs to accommodate separate external auxiliary supplies, or 16 single-ended (common return) digital inputs with an on-card blown fuse detector to accommodate a common external auxiliary supply for all channels. The selection of the Personality module determines if the inputs are differential or single-ended. The input voltage level monitored by the module is determined by the particular card group in the module.

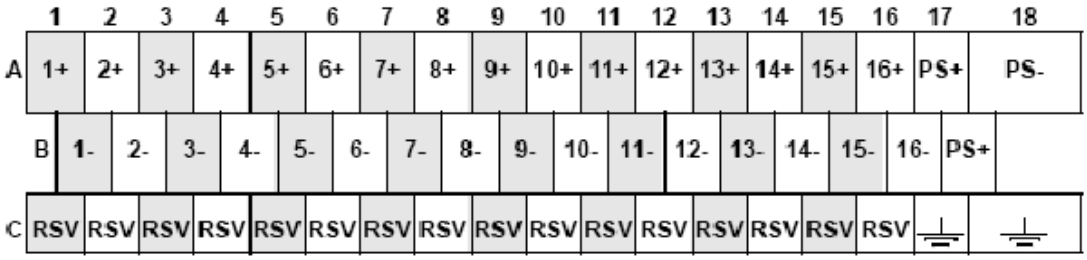
The field side circuitry for the single-ended configuration and the differential configuration is shown under Field Wiring Considerations for the Digital Input Configuration (see page 333). An input resistor provides the normal mode surge protection and limits the current during normal operation. An opto-isolator provides high dielectric isolation between the field side and the logic or I/O bus side. The Single-Ended Digital Input configuration has a circuit used to monitor the presence of the wetting supply. Two cases cause this monitor circuitry to report a blown fuse status and issue an attention status to the Ovation Controller:

- Fuse is blown on the PDIA.
- Auxiliary supply level is lower than minimum On Input Voltage.

Sequence of Events Digital Input Terminal Block Wiring Information

Each Personality module has a simplified wiring diagram label on its side, which appears above the terminal block. This diagram indicates how the wiring from the field is to be connected to the terminal block in the base unit. The diagrams for the Sequence of Events digital input Personality modules are illustrated below.

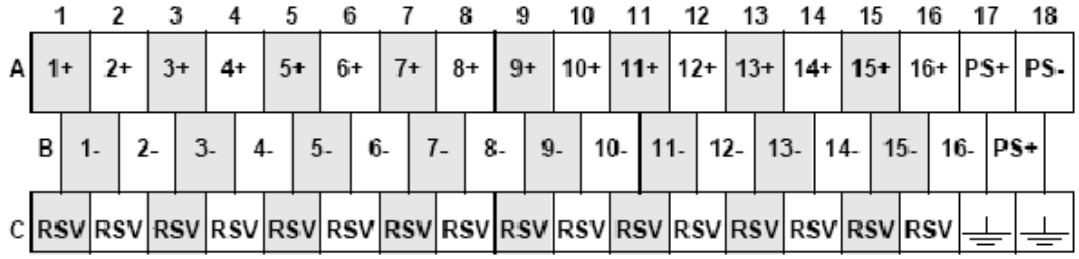
Single-Ended Digital Voltage Input: (1C31110G01)



Note

1. Forced signals are present on the reserved (RSV) pins due to backplane connections.

Differential Digital Voltage Inputs: (1C31110G02)

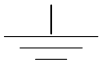


Notes

1. Forced signals are present on the reserved (RSV) pins due to backplane connections.
2. Each channel has a diode bridge at the front-end, therefore inputs to Row A and B are reversible.
3. The terminal block label indicates polarity only to be uniform with other terminal block labels where Row A is for high-side (+) signals, and Row B is for return (-) signals.

Figure 131: Terminal Block Connections for the RTD Pmod (1C31164G02)

Abbreviations Used in Diagrams

ABBREVIATION	DEFINITION
1+ through 16+	Digital input positive terminal connection
1- through 16-	Digital input negative terminal connection
	Earth ground terminals
PS+, PS-	Auxiliary Power Supply terminals
RSV	Reserved terminal. No connection allowed on these terminals

Note: *Do **not** use unmarked terminal block locations.*

FIELD WIRING CONSIDERATIONS FOR THE DIGITAL INPUT CONFIGURATION

The following maximum resistances of the cable and the interfaced device apply:

24 VDC - 100 KW
48 VDC - 150 KW
125 VDC - 250 KW

FIELD WIRING DIAGRAMS FOR THE DIGITAL INPUT CONFIGURATION

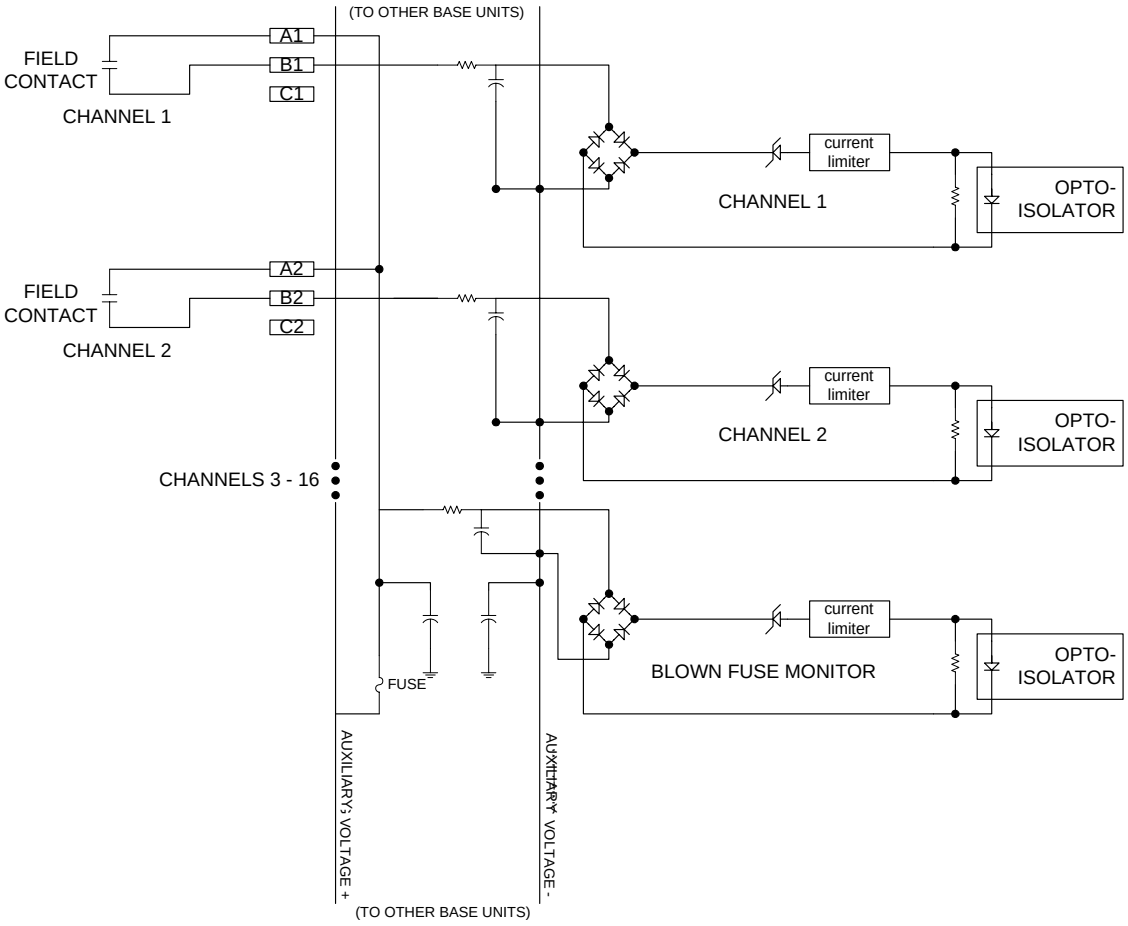


Figure 132: Sequence of Events Module Single-Ended Digital Input Front End

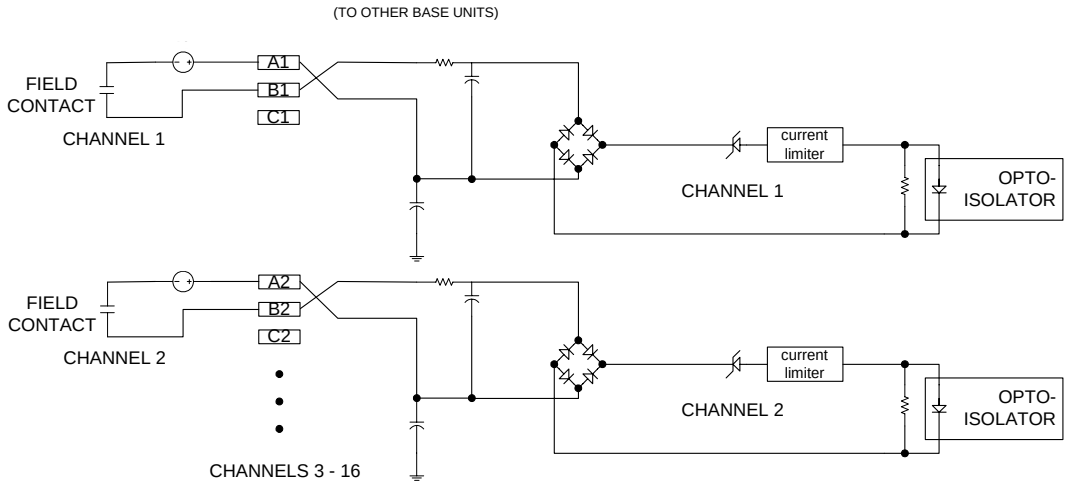
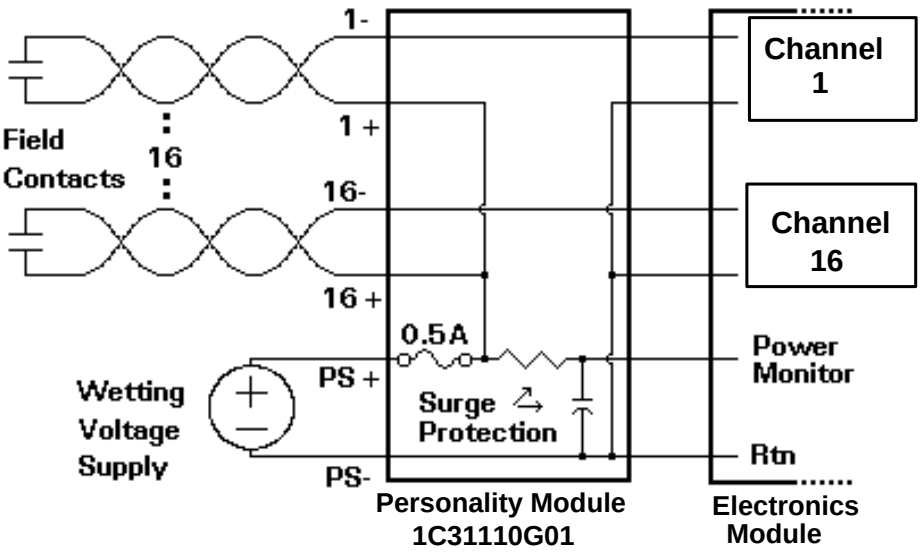


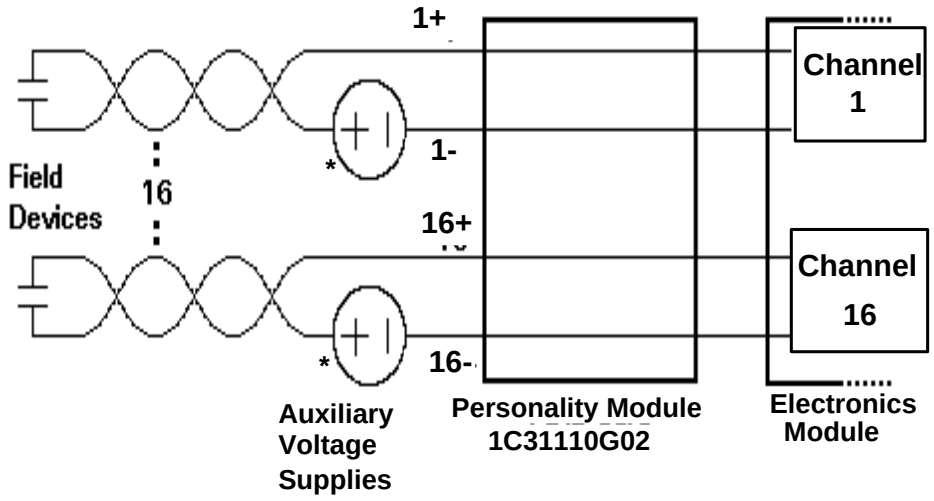
Figure 133: Sequence of Events Module Differential Digital Input Front End

SEQUENCE OF EVENTS DIGITAL INPUT FIELD CONNECTION WIRING DIAGRAM (NON-CE MARK)

Single-Ended Digital Voltage Inputs



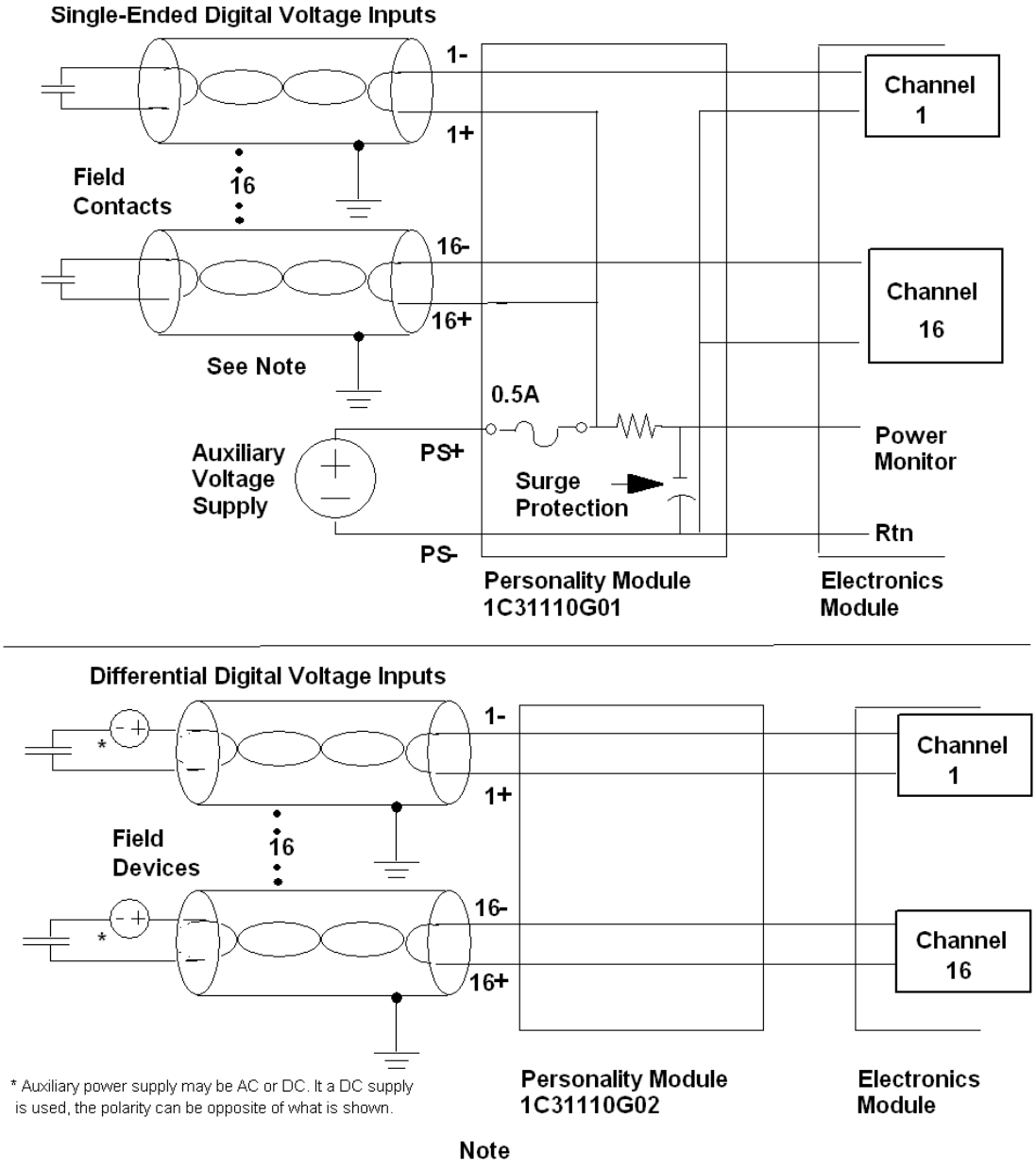
Differential Digital Voltage Inputs



* Auxiliary power supply may be AC or DC. It a DC supply is used, the polarity can be opposite of what is shown.

Figure 134: Field Connection for the SOE Digital Input Pmod (Non-CE Mark)

SEQUENCE OF EVENTS DIGITAL INPUT FIELD CONNECTION WIRING DIAGRAM (CE MARK)



Note

All field wiring must be braid-shielded and grounded at the entry point of the cabinet using the recommended hardware (refer to "Cable Guidelines" in the applicable Ovation system installation manual).

Figure 135: Field Connection for the SOE Digital Input Pmod (CE Mark)

Address Location Information

SEQUENCE OF EVENTS DIGITAL INPUT CONFIGURATION AND STATUS REGISTER

Word address 13 (D in Hex) is used to configure the module and provide status information to the Controller. The status register can be read by using the Point Information window at an Operator Station (see the Bit Pattern field on the Hardware tab). (See the *Ovation Operator Station User Guide*.)

Sequence of Events Digital Input Configuration/Status Register (Address 13 or D in Hex)

BIT	DATA DESCRIPTION - CONFIGURATION REGISTER (WRITE)	DATA DESCRIPTION - STATUS REGISTER (READ)
0	Configure Module	Module configured (1 = configured; 0=not configured)
1	Force internal error	Internal error (1 = forced error; 0=no forced error)
2 - 5	Not used. Should be set to zero (0).	Not used
6	Enable digital input blown fuse signal and module attention for blown fuse	Status of enable digital input blown fuse signal and module attention for blown fuse
7	Not used. Should be set to zero (0).	Blown fuse for digital input
8	Contact input field card (enable contact input auxiliary voltage failure signal and module attention for auxiliary voltage failure and ground fault detection)	Status of contact input field card (enable contact input auxiliary voltage failure signal and module attention for auxiliary voltage failure and ground fault detection circuitry)
9	Not used. Should be set to zero (0).	Auxiliary voltage failure for contact input
10	Enable module attention for a GND fault.	Status of Enable module attention for a GND fault.
11	Not used. Should be set to zero (0).	GND fault
12	Disable chatter control	Disable chatter control
13	Chatter control option.	Status of chatter control option.
14	Not used. Should be set to zero (0).	Clock synchronized.
15	Not used. Should be set to zero (0).	Not used.

Bit 0: Module will not operate until this bit is set with a write.

Bit 1: When this bit is set, the internal error LED is turned on, and only the status registers can be read.

Bit 6: This bit should be set for a single-ended input and cleared for a differential input.

Bits 8 - 10: These bits should be cleared to zero (0).

Bit 12: When this bit is set and an input channel is not masked off, that input can chatter and each event will be recorded until the event buffer overflows. Default state is “0” and enables the chatter control function.

Bit 13: When this bit is set, chatter will be flagged when an input changes state four or more times between event buffer reads. When cleared, chatter will be flagged for state changes greater than 1 per 100 milliseconds.

Bits 14 - 15: Not used in the Configuration Register. Bit 14 is clock synchronized in the Status Register.

SECONDARY/EXPANSION CONFIGURATION AND STATUS REGISTER

Word address 14 (E in Hex) is used to enable or disable the channel event tagging mask.

Secondary/Expansion Configuration/Status Register (Address 14 or E in Hex)

BIT	DATA DESCRIPTION - CONFIGURATION (WRITE)	DATA DESCRIPTION - STATUS (READ)
0 - 15	Channel Event Tagging mask	Channel Event Tagging mask

Specifications, Sequence of Events Digital Input

Electronics Module (1C31157G01 and 1C31157G02)

Personality Module (1C31110G01 and 1C31110G02)

Sequence of Events Digital Input Specifications

DESCRIPTION	VALUE
Number of channels	16
Input range (single-ended or differential) [1]	Refer to the table below
Propagation delay of contact change of state [2] 24V/48V DC 125VDC	 3.75 mSec minimum; 4.25 mSec maximum 3.75 mSec minimum; 4.45 mSec maximum
Signal rejection Always rejects change of state Always accepts change of state	 < 3.87 mSec > 4.13 mSec
Cable length (quality is 50pF/ft or better)	1000 feet maximum
Diagnostics	Internal module operating faults and Blown fuse detection. [3]
Dielectric isolation: Channel to channel [4] Channel to logic	 1000 V DC 500 V AC 1000 V AC/DC
Module power from logic supply	Main: 1.44 W typical, 1.8 W maximum
Operating temperature range	0 to 60×C (32×F to 140×F)

DESCRIPTION	VALUE
Storage temperature range	-40×C to 85×C (-40×F to 185×F)
Humidity (non-condensing)	0 to 95%

[1] Input range level is dependent on module group.

[2] Does not include cable capacitance.

[3] Blown fuse detection applies to single-ended channel configuration only, where an on-board fuse is provided for the auxiliary power supply.

[4] Channel to channel isolation applies to differential channel configuration only.

Sequence of Events Digital Input Ranges

INPUT LEVEL	ON INPUT VOLTAGE (VDC) MIN	MAX	OFF INPUT VOLTAGE (VDC) MAX	ON INPUT CURRENT (MA) Min	Max	OFF INPUT (WATTS) MAX	INPUT POWER TYPICAL
24 VDC	18	60	9	0.9	2.6	0.3	1.1
48 VDC	18	60	9	0.9	2.6	0.3	2.2
125 VDC	80	140	55	0.6	1.5	0.3	3.3

Diagnostic LEDs, Sequence of Events Digital Input

Sequence of Events Digital Input Diagnostic LEDs

LED	DESCRIPTION
P (Green)	Power OK LED. Lit when the +5V power is OK.
C (Green)	Communications OK LED. Lit when the Controller is communicating with the module.
E (Red)	For Single-ended Digital Input: Lit when fuse blows or there is a loss of the auxiliary power supply (only when Bit 6 of Configuration register is set; then Bit 7 of the Status register is set). For Differential Digital Input: Not lit since the configuration bit is not set, and the blown fuse signal from the field card is ignored.
I (Red)	Internal Fault LED. Lit whenever the Force Error bit (Bit 1) of the Configuration Register (see page 338) is set, or when a timeout of the watchdog timer occurs when the Controller stops communicating with the module. Also lit when Controller stops communicating with the module.
CH1 through CH16 (Green)	Lit when the input voltage of the LED's corresponding channel is greater than the channel's minimum "On Input Voltage."

23.4.2 SEQUENCE OF EVENTS CONTACT FIELD INTERFACE MODULES

Contact Input Field Interface

The Contact Input configuration provides 16 contact input current detecting channels with common returns. The field side circuitry and terminal connections for three of these channels are shown in Field Wiring Diagrams for the Contact Input Configuration (see page 342).

A +48V on-board power supply provides current limited contact wetting voltage if the contact is open. If the contact closes, current is drawn from the +10V supply which turns on the associated opto-isolator; thereby, relaying a closed contact state to the I/O bus. The opto-isolators and the isolation provided by the 10V and 48 V power supply provide high dielectric isolation between the field side and the logic or I/O bus side.

There are two methods of wiring field devices to the termination block. Each field contact may have a separate input and return line as shown for channel 1. Alternatively, field contacts wired to the same module may share a return line as shown for channels 2 and 3. For either wiring method, **do not** tie the contact return line to earth ground or a ground fault condition will occur as well as a degradation of the common mode surge protection.

Ground fault detection circuitry on the Sequence of Events module with Contact Inputs activates when the input or return line for any channel finds a low impedance (<10K ohms) path to earth ground. A single wire with a ground fault will not cause an error in the point data, but multiple ground faults (if they include input and return lines) could cause faulty data (that is, channels appearing as if their contacts are closed when they are really open).

When a ground fault occurs, the external error LED lights, and the GND Fault bit 11 in the Status Register is set. If the GND Fault Attention Enable bit 8 is set in the Configuration Register, a ground fault is seen as a catastrophic error causing an attention status to be sent back to the Controller. See Field Wiring Diagrams for the Contact Input Configuration (see page 342) for ground fault detection circuitry.

FIELD WIRING CONSIDERATIONS FOR THE CONTACT INPUT CONFIGURATION

The following definitions apply to the restrictions listed below:

- Rshunt = contact shunt resistance
- Rcontact = resistance associated with a closed contact
- Rreturn = resistance of the common return line
- Rline = resistance of the non-common cable length to and from the contact
- Rwiring = Rcontact + Rline + 16Rreturn
- Rfault = resistance from either line to ground which causes a ground fault

Field Wiring Diagrams for the Contact Input Configuration (see page 342) shows possible cable resistances that affect contact input performance. The following restrictions apply:

- Under no-ground-fault conditions or if the channel return (low) line has a ground fault:
  - Rshunt across contact must be greater than or equal to 10k ohms to always recognize an open contact as open.
  - Rshunt across contact must be greater than or equal to 50k ohms to maintain the high level contact-wetting voltage.

- If the input connection from a channel has a ground fault with the contact open:
  - Rshunt across contact must be greater than or equal to 150k ohms to guarantee ground fault is detected.
- For a ground fault on the input or return connection to a channel:
  - Rfault from either line to ground must be less than or equal to 5K ohms to guarantee detection of the ground fault.
- With or without ground fault conditions:
  - Rwiring through field wiring to contact must by less than 100 ohms to always recognize a closed contact as closed.

FIELD WIRING DIAGRAMS FOR THE CONTACT INPUT CONFIGURATION

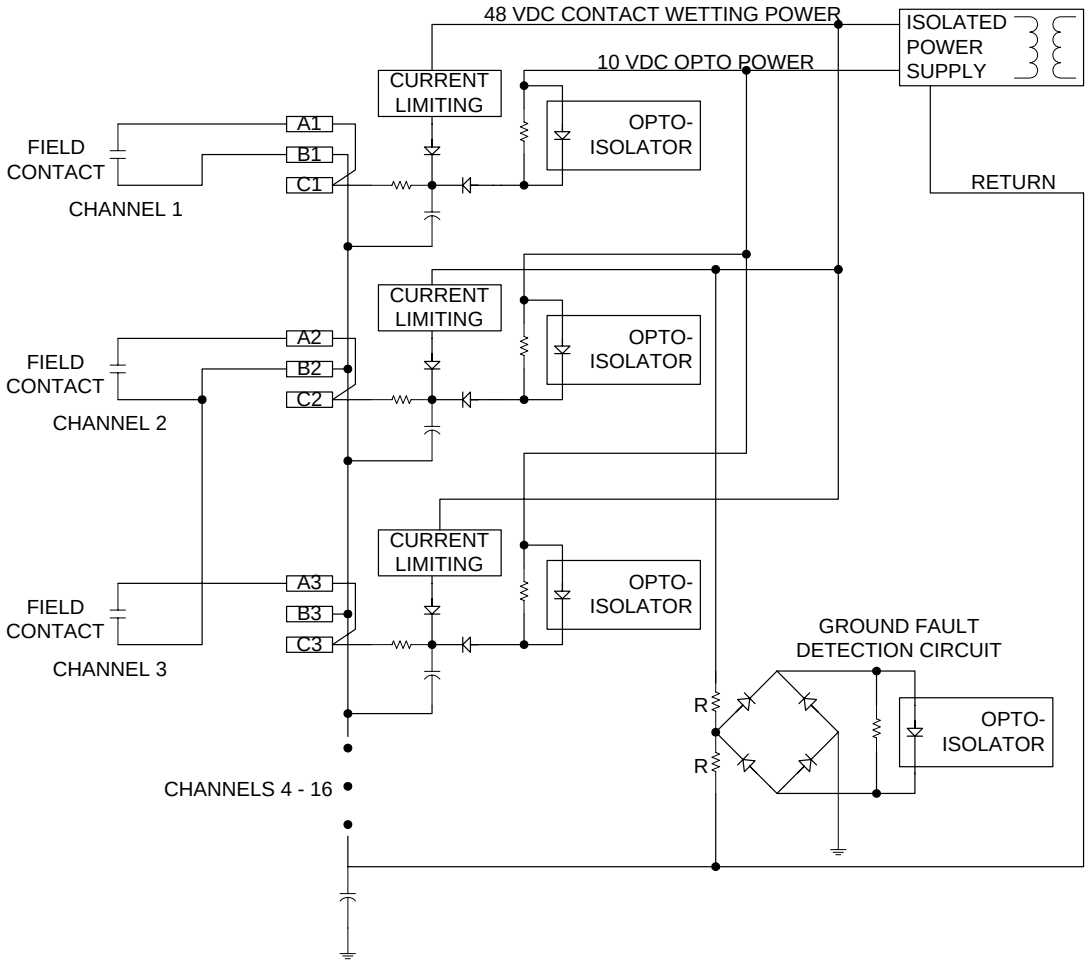


Figure 136: Sequence of Events Module Contact Input Front End

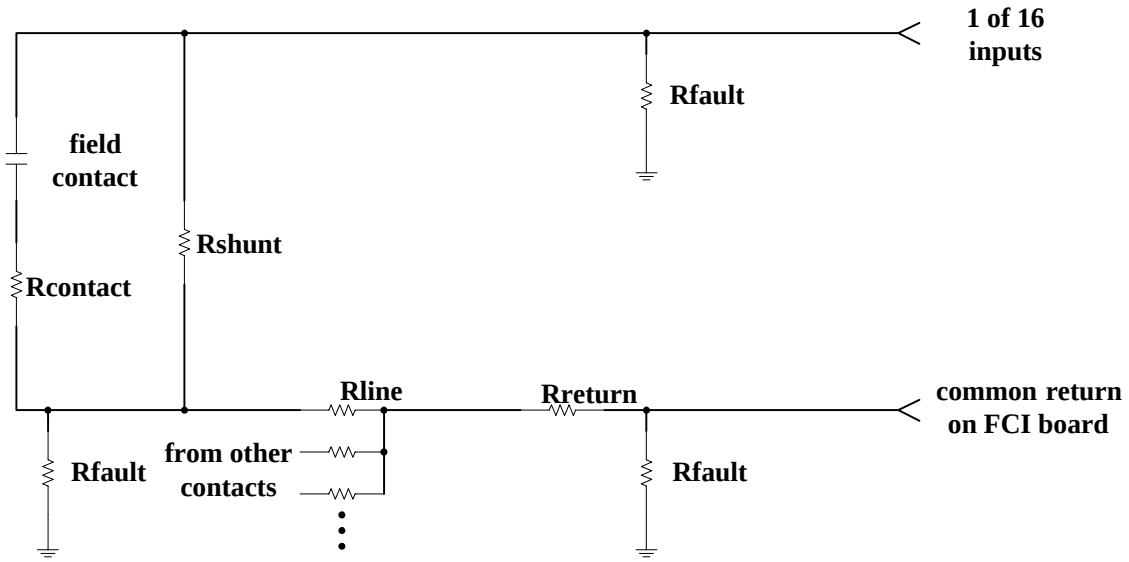


Figure 137: Cable Impedances in Field Wiring

FIELD WIRING CABLE LENGTHS

The following two tables list the maximum cable lengths for field wiring to the contacts. For both, assume Rcontact is 0 ohms.

The table below applies when there are individual common return lines (see page 342) brought to the card edge. This implies that Rreturn is 0 ohms.

Maximum Cable Length for 16 Individual Common Returns

WIRE GAUGE	OHMS PER THOUSAND FEET (SOLID COPPER WIRE)	MAXIMUM CABLE LENGTH (THOUSANDS OF FEET)
18	6.64	7.5
20	10.2	4.9
22	16.2	3.0

The table below applies when all 16 channels share a common return line. In both tables, the Maximum Cable Length is the length of the cables from the termination block to the contacts in the field.

Maximum Cable Length for a Single Common Return for All 16 Inputs

WIRE GAUGE	OHMS PER THOUSAND FEET (SOLID COPPER WIRE)	MAXIMUM CABLE LENGTH (THOUSANDS OF FEET)
12	1.66	3.54
14	2.27	2.59
16	4.18	1.40

WIRE GAUGE	OHMS PER THOUSAND FEET (SOLID COPPER WIRE)	MAXIMUM CABLE LENGTH (THOUSANDS OF FEET)
18	6.64	0.89

Sequence of Events Contact Input Terminal Block Wiring Information

The diagram for the Sequence of Events contact input Personality module is illustrated in the figure below.

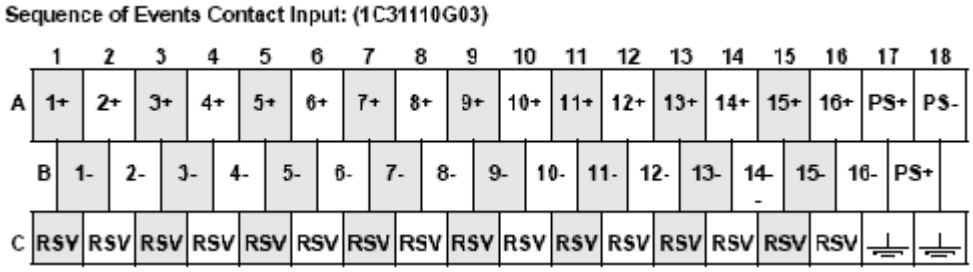
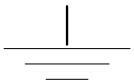

Sequence of Events Contact Input: (1C31110G03)
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18
A 1+ 2+ 3+ 4+ 5+ 6+ 7+ 8+ 9+ 10+ 11+ 12+ 13+ 14+ 15+ 16+ PS+ PS-
B 1- 2- 3- 4- 5- 6- 7- 8- 9- 10- 11- 12- 13- 14- 15- 16- PS+
C RSV RSV RSV RSV RSV RSV RSV RSV RSV RSV RSV RSV RSV RSV RSV RSV

Figure 138: Terminal Block Connections for the Sequence of Events Contact Input Personality Modules

The following table lists and defines the abbreviations used in this diagram.

Abbreviations Used in Diagrams

ABBREVIATION	DEFINITION
1+ through 16+	Contact input positive terminal connection.
1- through 16-	Contact input negative terminal connection.
	Earth ground terminals.
PS+, PS-	Auxiliary Power Supply terminals.
RSV	Reserved terminal. No connection allowed on these terminals.

Note: *Do* ***not*** *use terminal block locations marked RSV.*

SEQUENCE OF EVENTS CONTACT INPUT FIELD CONNECTION WIRING DIAGRAM (NON-CE MARK)

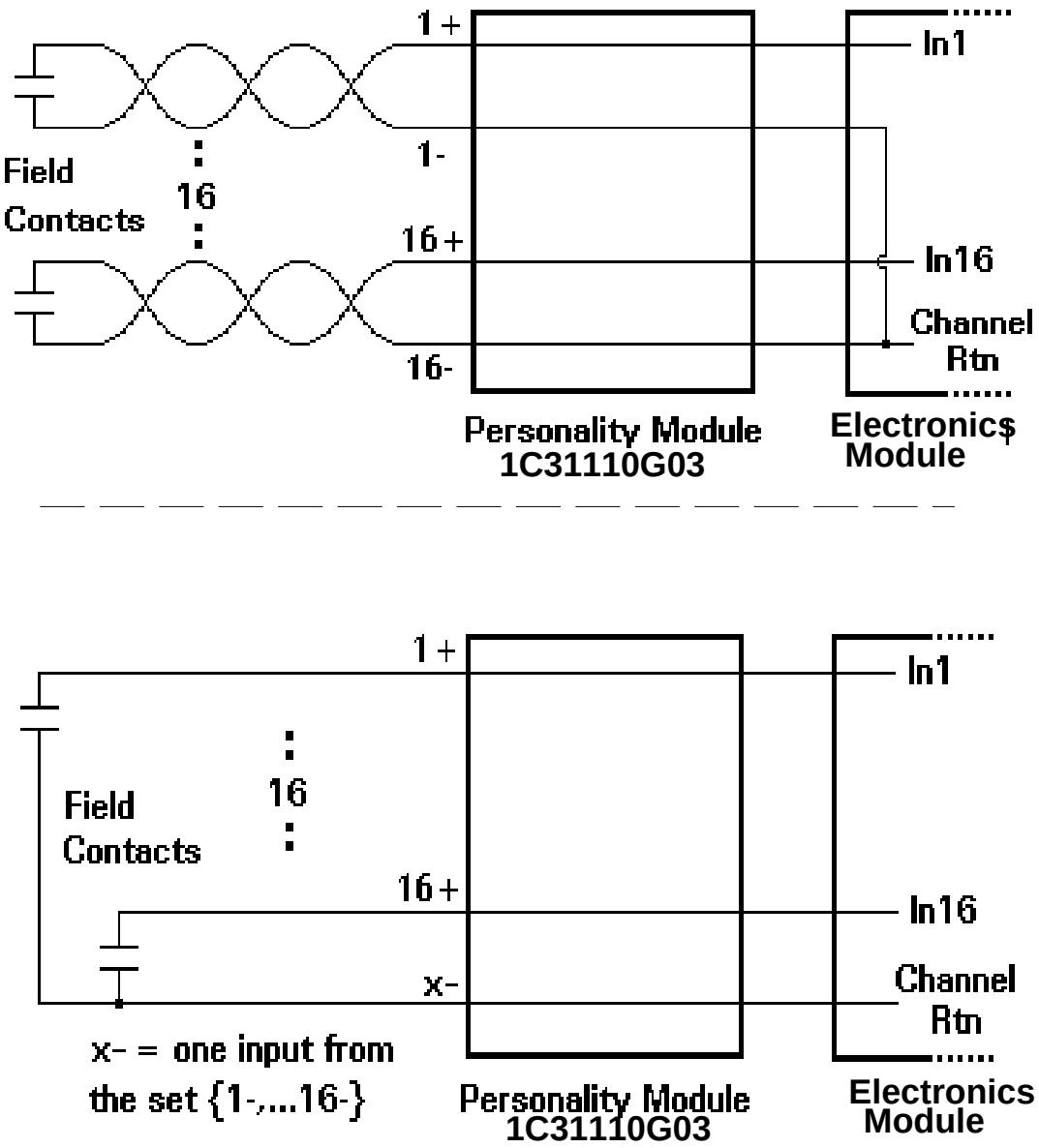
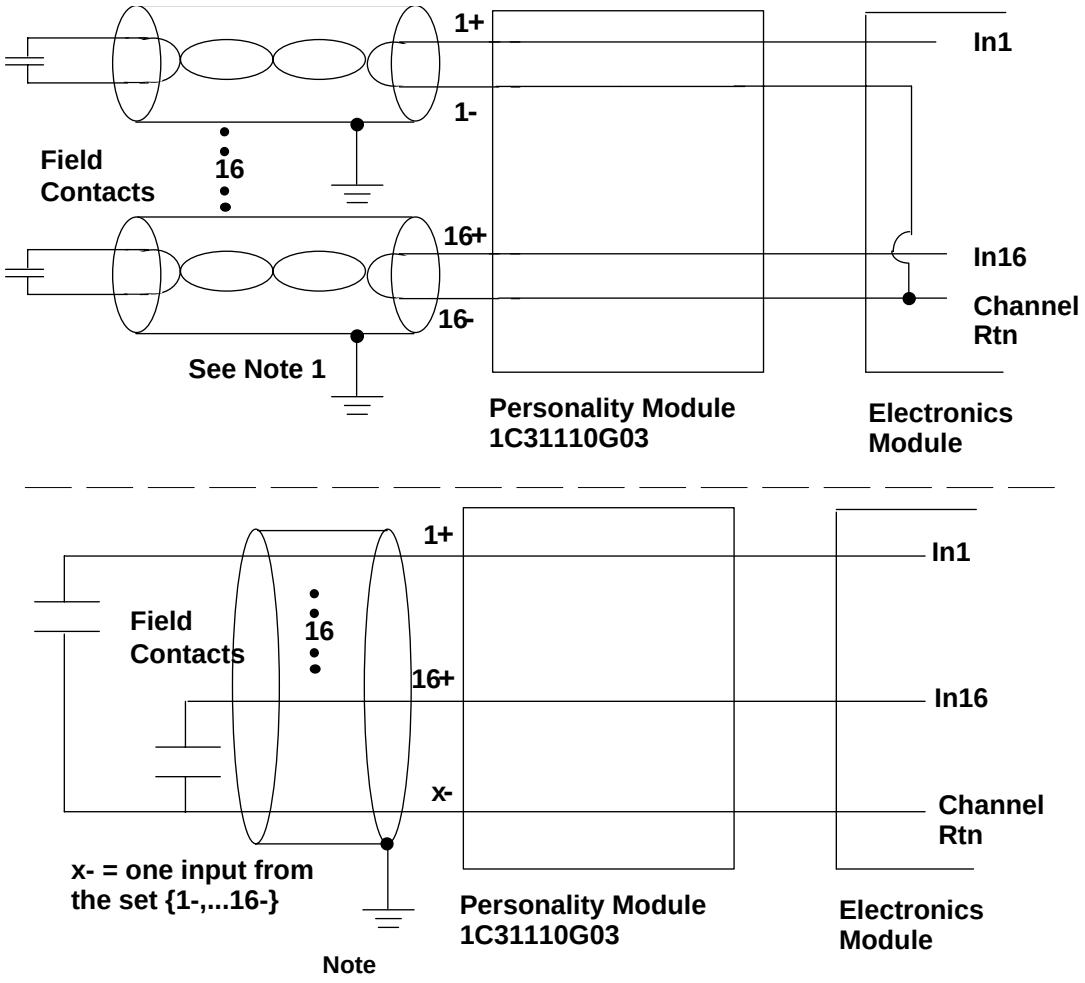


Figure 139: Field Connection for the SOE Contact Input Pmod (Non-CE Mark)

SEQUENCE OF EVENTS CONTACT INPUT FIELD CONNECTION WIRING DIAGRAM (CE MARK)



All field wiring must be braid-shielded and grounded at the entry point of the cabinet using the recommended hardware (refer to "Cable Guidelines" in the applicable Ovation system installation manual).

Figure 140: Field Connection for the SOE Contact Input Pmod (CE Mark)

23.5 Address Location Information

23.5.1 Sequence of Events Contact Input Configuration and Status Register

Word address 13 (D in Hex) is used to configure the module and provide status information to the Controller. The status register can be read by using the Point Information window at an Operator Station (see the Bit Pattern field on the Hardware tab). (See the *Ovation Operator Station User Guide.)*

Sequence of Events Contact Input Configuration/Status Register (Address 13 or D in Hex)

Bit	Data Description - Configuration Register	Data Description - Status Register (Read)
0	Configure Module.	Module configured (1 = configured; 0 = unconfigured)
1	Force internal error.	Internal error (1 = forced error; 0 = no forced error)
2 - 5	Not used.	Not used.
6	Enable digital input blown fuse signal and module attention for blown fuse.	Status of enable digital input blown fuse signal and module attention for blown fuse.
7	Not used. Should be set to zero (0).	Blown fuse for digital input
8	Contact input field card (enable contact input auxiliary voltage failure signal and module attention for auxiliary voltage failure and ground fault detection circuitry).	Status of contact input field card (enable contact input auxiliary voltage failure signal and module attention for auxiliary voltage failure and ground fault detection circuitry).
9	Not used. Should be set to zero (0).	Auxiliary voltage failure for contact input.
10	Enable module attention for a GND fault.	Status of Enable module attention for a GND fault.
11	Not used. Should be set to zero (0).	GND fault.
12	Disable chatter control.	Disable chatter control.
13	Reset chatter control counters on buffer unfreeze (instead of decrementing every 100 milliseconds).	Status of reset chatter control counters on buffer unfreeze (instead of decrementing every 100 milliseconds).
14	Not used. Should be set to zero (0).	Clock synchronized.
15	Not used. Should be set to zero (0).	Not used.

Bit 0: Module will not operate until this bit is set with a write.

Bit 1: When this bit is set, the internal error LED is turned on, and only the status registers can be read.

Bits 2 - 5, 7, 9, 11, 14 - 15: Not used.

Bit 6: This bit should be cleared to zero (0).

Bit 8: This bit should be set.

Bit 10: This bit should be set according to application need.

Bit 12: When this bit is set and an input channel is not masked off, that input can chatter and each event will be recorded until the event buffer overflows. Default state is “0” and enables the chatter control function.

Bit 13: When this bit is set, the chatter control counter for each channel is reset each time an event buffer is unfrozen instead of being decremented each 100 milliseconds. Default state is “0” and has the chatter control counter being decremented every 100 milliseconds.

23.6 DIAGNOSTIC LEDS

The following table lists the module’s LEDs and describes what they mean when lit.

Sequence of Events Contact Input Diagnostic LEDs

LED	DESCRIPTION
P (Green)	Power OK LED. Lit when the +5V power is OK.
C (Green)	Communications OK LED. Lit when the Controller is communicating with the module.
E (Red)	External fault. Lit when a ground fault occurs in the field wiring. Ground fault is also indicated in bit 12 (GND fault) of the Status register.
I (Red)	Internal fault. Lit when the internal on-card +48V/+10V contact auxiliary power supply has failed. Only lit if Bit 8 of the Configuration register is set.
CH1 through CH16 (Green)	Lit when the input contact of the LED’s corresponding channel is closed.

23.7 SPECIFICATIONS

Electronics Module (1C31157G03)

Personality Module (1C31110G03)

Sequence of Events Contact Input Module Specifications

DESCRIPTION	VALUE
Number of channels	16
On board auxiliary power supply	42 V minimum 55 V maximum
Signal rejection Always rejects contact change of state Always accepts contact change of state	 < 3.87 mSec > 4.13 mSec
Propagation delay of contact change of state [1]	3.75 mSec minimum; 4.4 mSec maximum

DESCRIPTION	VALUE
Closed contact output current	4 mA minimum 8 mA maximum
Diagnostics	Internal module operating faults Ground Fault Detection
Dielectric isolation: Channel to logic	 1000 V AC/DC
Module power from logic supply	4.56 W typical (all inputs on) 5.0 W maximum
Operating temperature range	0 to 60°C (32°F to 140°F)
Storage temperature range	-40°C to 85°C (-40°F to 185°F)
Humidity (non-condensing)	0 to 95%
[1] Does not include cable capacitance.	

SECTION 24

COMPACT SEQUENCE OF EVENTS MODULE

IN THIS SECTION

Description *352*
Module Group Information *353*
Module Specific Information *354*
Wiring Information, Sequence of Events Modules *355*
Diagnostic LEDs *371*
Specifications *371*

24.1 DESCRIPTION

The Compact Sequence of Events (SOE) module provides 16 digital channels to monitor the open or closed state of digital inputs or contacts in the field. The module provides a filter to reject changes of state less than four milliseconds. The Compact Sequence of Events module can also perform event tagging and chatter control for each input channel.

The Ovation Controller writes a channel event tagging mask to the Electronics module to enable event tagging for specific input channels. It has a chatter control flag for each channel to indicate that the input channel has changed state too many times in a period of time, or is changing state at too fast a rate. It also has a channel ID to indicate which channel changed state. Each channel is checked every 125 micro-seconds. If the channel event tagging mask bit is zero, that channel is not checked.

If there is an input channel state change, the change is recorded in the SOE module's Event Buffer and the input channel's Chatter counter is incremented. When the input channel's Chatter counter value reaches four, any additional state changes are not recorded for that input channel. The recording of additional state changes for that input channel is inhibited until the input channel Chatter counter is reset to a zero value.

A control bit written by the Ovation Controller provides two options for resetting an input channel's Chatter counter:

- Each input channel's Chatter counter is reset after the Ovation Controller reads the SOE module's Event Buffer. With this option selected, the SOE module will identify up to four state changes for each of its input channels between successive Ovation Controller Event Buffer read operations.
- Each input channel's Chatter counter is checked every 100 milliseconds and is decremented if its value is greater than zero. When the input channel's Chatter counter value reaches zero, future input channel state changes may be entered into the Event Buffer. With this option selected, an input state change rate greater than 1 per 100 milliseconds will result in no new Event Buffer entries for that input channel while a lower input state change rate will allow new Event Buffer entries for that input channel.

The Compact Sequence of Events module is applicable for CE Mark certified systems.

There are two 32 event buffers. This allows the event tagging and chatter control function to be writing into one event buffer while the Ovation Controller is reading the other event buffer. The Ovation Controller only reads each module a small portion of the loop time. This allows both event buffers to be available the rest of the loop time.

Each event buffer contains 64 words with up to 32 Channel-IDs and 32 Event-Times. The event buffers are memories. The memory control circuit controls which event buffer to write into and which event buffer to read from. Before reading the event buffer, the buffer status register must be read to determine the number of words to read.

Time synchronization is accomplished by the Ovation Controller writing a time reference simultaneously to all Sequence of Events modules with a 1 millisecond resolution. The Compact Sequence of Event Module is CE Mark applicable.

Note: *I/O Module General Information (see page 15) contains environmental, installation, wiring, and fuse information for I/O modules.*
All SOE modules in a Controller MUST be connected to the IOIC card that is configured as the Time Keeper.

CAUTION! Do NOT mix the Compact Sequence of Events module (1C31233) with the Sequence of Events module (1C31157) in the same system.

CAUTION! CE Mark certified systems: Any base unit that contains a 125VDC Compact Sequence of Events Electronics module (1C31233G03) with Foam Insert (1C31238H01) and interfaces to hazardous voltage (>60 VDC) must include a hazardous voltage warning label (1B30025H01) on that base unit.
Any base unit containing a 125VDC Compact Sequence of Events Electronics module (1C31233G03) with Fused Digital Input Personality module (5X00034G01) and interfaces to hazardous voltage (>60 VDC) must include a hazardous voltage warning label (1B30025H01) on ALL base units on the branch.
This label must be placed in a visible location on the base unit, preferably above the spare fuse location. The project drawings must indicate this.

The Sequence of Events module comes in five combinations of Electronics and Personality Modules:

- 24/48 VDC single-ended digital input.
- 24/48 VDC differential input.
- 125 VDC single-ended digital input.
- 125 VDC differential input.
- 48 VDC contact input with on card auxiliary supply.

24.2 Module Group Information

24.2.1 Electronics Modules (Emods)

There are four Electronics module groups for the Compact Sequence of Events Module:

- **1C31233G01** provides for 24/48 VDC single-ended inputs.
- **1C31233G02** provides for 24/48 VDC differential inputs and supports the 16 point individually fused option.
- **1C31233G03** provides for 125 VDC differential inputs and supports the 16 point individually fused option.
- **1C31233G04** (Contact Input) provides for 48 VDC on-card auxiliary power.

Personality Module (Pmods)

There is one Personality module group for the Compact Sequence of Events Module:

- **5X00034G01** provides for 16 point individual fusing with a common supply.

This is an optional Personality module that is available for use with the differential input Electronics modules (**1C31233G02**, **1C31233G03**) for applications requiring individual point fusing with a common supply.

Foam Insert

There is no Personality module required for use with the Compact Digital Input subsystem (except for the 16 point individually fused option **5X00034G01**). A foam insert is available that fits into the Personality module cavity in the Base Unit and provides wiring information.

- **1C31238H01**

Subsystems, Compact Sequence of Events

Compact Sequence of Events Subsystems [1]

RANGE	CHANNELS	ELECTRONIC MODULE	PERSONALITY MODULE OR CAVITY INSERT [1]
24/48 VDC (Single-ended) Digital input	16	1C31233G01	1C31238H01[2]
24/48 VDC (Differential) Digital input	16	1C31233G02	5X00034G01 (Fused Pmod) 1C31238H01[2] (Cavity Insert)
125 VDC (Differential) Digital input	16	1C31233G03	5X00034G01 (Fused Pmod) 1C31238H01[2] (Cavity Insert)
48 VDC On-Card auxiliary (Contact Input)	16	1C31233G04	1C31238H01[2]

[1] All Configurations are CE Mark certified.

[2] This is an insert that fits into the Personality module position and provides a wiring schematic label for the module.

When the 125VAC/VDC Compact Digital Input Emod (1C31233G03) is used in applications without the Fused Pmod (5X00034G01), additional external fusing or other current limiting devices are recommended on the hazardous inputs to provide additional protection to the external wiring and power source.

24.3 MODULE SPECIFIC INFORMATION

24.3.1 EXTERNAL POWER SUPPLIES

When using the **1C31233G01** single-ended module, or **1C31233G02/G03** with Personality module **5X00034G01**, the required voltage source may be obtained from the internal auxiliary power supply (Controller backplane) or it may be obtained from an external power supply.

If an external power supply is used, Using an External Power Supply (see page 539) contains steps to be undertaken before connecting the external power supply to the Compact Sequence of Events Digital Input module base unit terminal block.

24.4 Wiring Information, Sequence of Events Modules

The Sequence of Events modules can be divided into two types depending on their front end connections, Digital Input Field Interface or Contact Filed Interface. The digital Input field Interface modules can be broken down further into Single-Ended and Differential as well as low and high voltage.

The following wiring section topics will be split to show the wiring of the Sequence of Events Digital Input Field Interface modules, then the Sequence of Events Contact Filed Interface modules.

24.4.1 Sequence of Events Digital Input Field Interface Modules

Digital Input Field Interface

The Digital Input configuration contains 16 channels, where each channel has voltage level sensing circuitry used to detect whether an input is on or off. Style 1C31233G02/G03 has 16 isolated differential inputs to accommodate separate external auxiliary supplies. Style **1C31233G01** has 16 single-ended (common return) digital inputs with an on-card blown fuse detect to accommodate a common external auxiliary supply for all channels. The input voltage level monitored by the module is determined by the particular card group in the module.

Also, Style **1C31233G02/G03** can be used with the individually fused Personality module **5X00034G01** for applications requiring individual point fusing with a common supply.

An input resistor provides the normal mode surge protection and limits the current during normal operation. An opto-isolator provides high dielectric isolation between the field side and the logic or I/O bus side. The Single-Ended Digital Input configuration has a circuit used to monitor the presence of the wetting supply. Two cases cause this monitor circuitry to report a blown fuse status and issue an attention status to the Ovation Controller:

- Fuse is blown on the module.
- Auxiliary supply level is lower than minimum On Input Voltage.

Field Wiring Considerations for the Digital Input Configuration

The following maximum resistances of the cable and the interfaced device apply:

24 VDC - 100 KW; 48 VDC - 150 KW; 125 VDC 250 KW

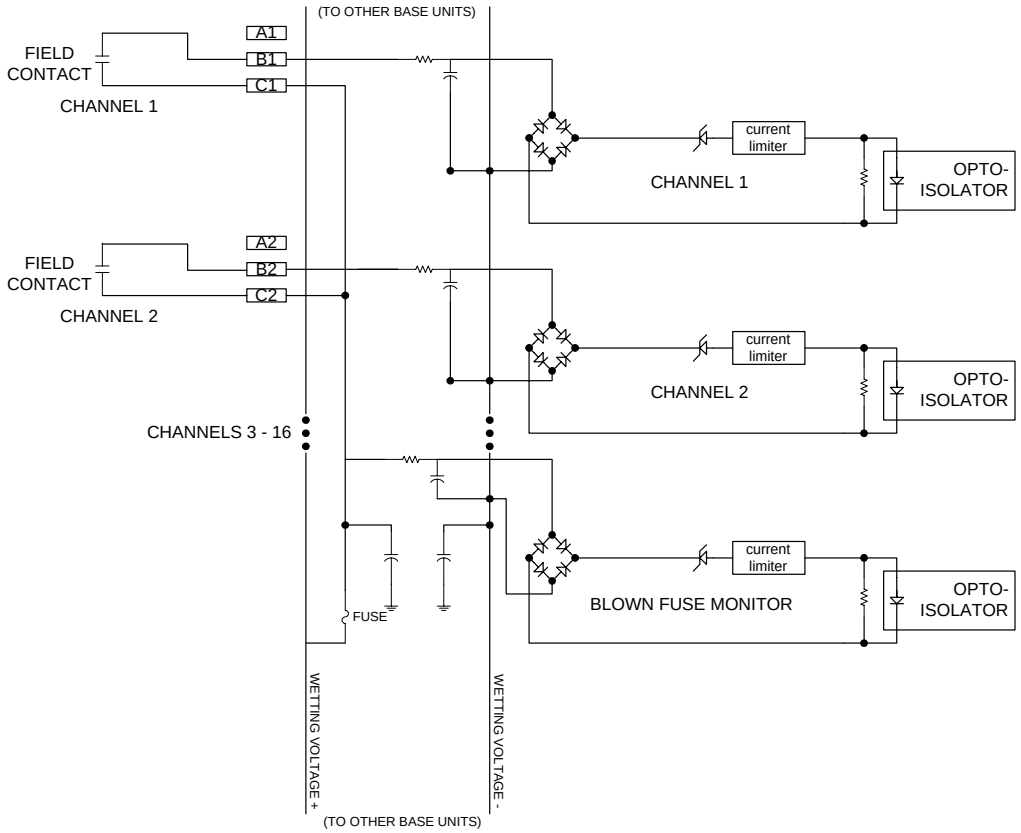


Figure 141: Compact SOE Module Single-Ended Digital Input Front End

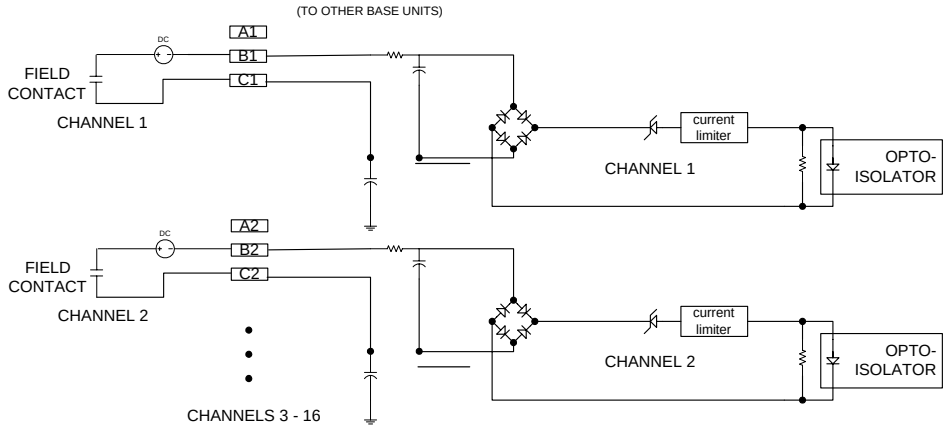


Figure 142: Compact Sequence of Events Module Differential Digital Input Front End

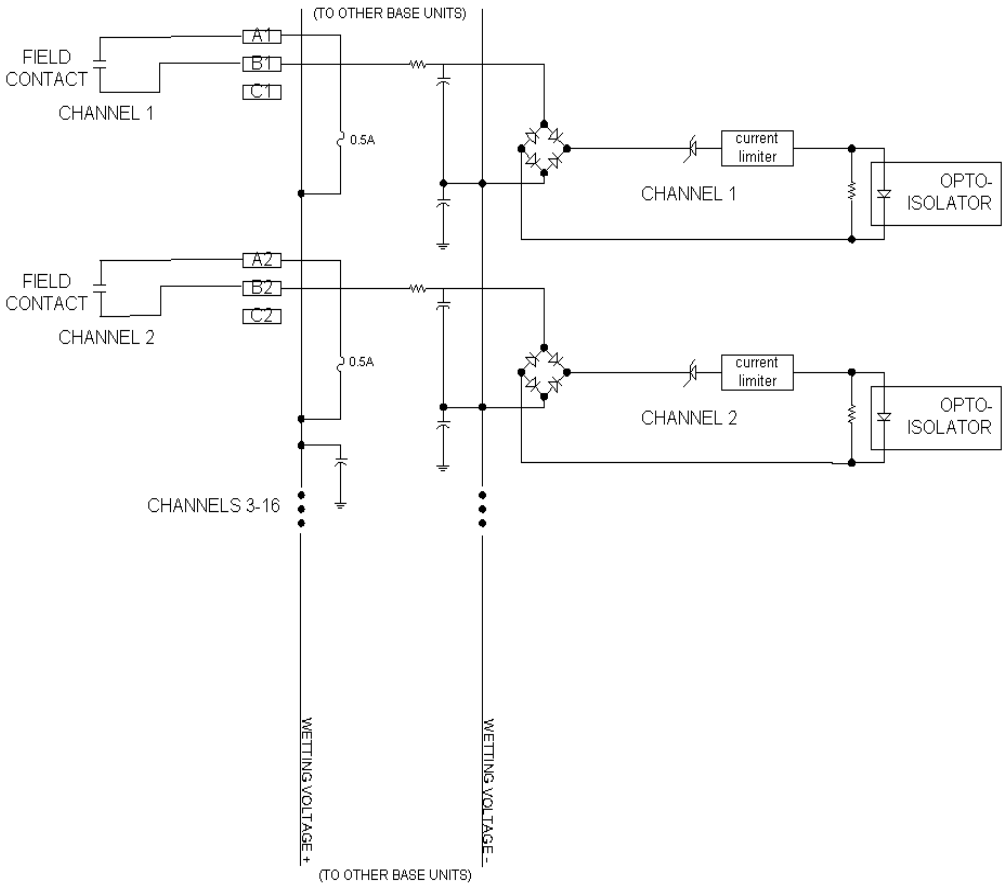


Figure 143: 16 Individually Fused Compact Digital Inputs Front End

Compact SOE Digital Input Module Emod (1C31233G01 through G03)

Compact Sequence of Events Digital Input Specifications

DESCRIPTION	VALUE
Number of channels	16
Input range (single-ended or differential) [1]	Refer to the table below.
Propagation delay of contact change of state [2] 24V/48V DC 125VDC	 3.75 mSec minimum; 4.25 mSec maximum 3.75 mSec minimum; 4.45 mSec maximum
Signal rejection Always rejects change of state Always accepts change of state	 < 3.87 mSec > 4.13 mSec
Cable length (quality is 50pF/ft or better)	1000 feet maximum

DESCRIPTION	VALUE
Diagnostics	Internal module operating faults and Blown fuse detection. [3]
Dielectric isolation: Channel to channel [4] Channel to logic	 1000 VAC 2000 VAC differential; 1000 VAC others
Module power from logic supply	Main: 1.44 W typical, 1.8 W maximum
Operating temperature range	0 to 60°C (32°F to 140°F)
Storage temperature range	-40°C to 85°C (-40°F to 185°F)
Humidity (non-condensing)	0 to 95%

[1] Input range level is dependent on module group.

[2] Does not include cable capacitance.

[3] Blown fuse detection applies to single-ended channel configuration only, when an on-board fuse is provided for the auxiliary power supply.

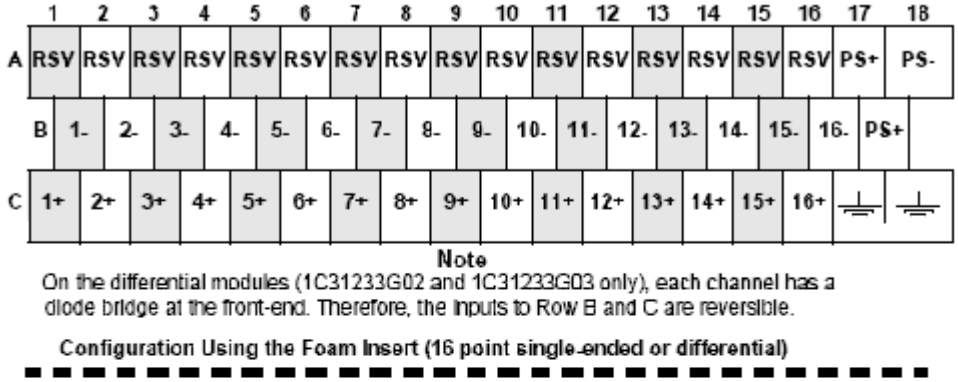
[4] Channel to channel isolation applies to differential channel configuration only.

Compact Sequence of Events Digital Input Ranges

INPUT LEVEL	ON INPUT VOLTAGE (VDC)		OFF INPUT VOLTAGE (VDC)	ON INPUT CURRENT (MA)		OFF INPUT (WATTS)	INPUT POWER
	Min	Max	MAX	Min	Max	MAX	TYPICAL
24 VDC	20	60	9	1.3	2.6	0.33	0.65
48 VDC	20	60	9	1.3	2.6	0.33	1.7
125 VDC	80	140	55	1.3	2.8	0.33	4.26

Compact SOE Digital Input Terminal Block Wiring Information

The available foam insert has a simplified wiring diagram label on top, which appears above the terminal block. This diagram indicates how the wiring from the field is to be connected to the terminal block in the base unit. The diagrams for the Compact Sequence of Events Digital Input module are illustrated below.


1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18
A RSV RSV RSV RSV RSV RSV RSV RSV RSV RSV RSV RSV RSV RSV RSV RSV PS+ PS-
B 1- 2- 3- 4- 5- 6- 7- 8- 9- 10- 11- 12- 13- 14- 15- 16- PS+
C 1+ 2+ 3+ 4+ 5+ 6+ 7+ 8+ 9+ 10+ 11+ 12+ 13+ 14+ 15+ 16+
Note
On the differential modules (1C31233G02 and 1C31233G03 only), each channel has a diode bridge at the front-end. Therefore, the inputs to Row B and C are reversible.
Configuration Using the Foam Insert (16 point single-ended or differential)

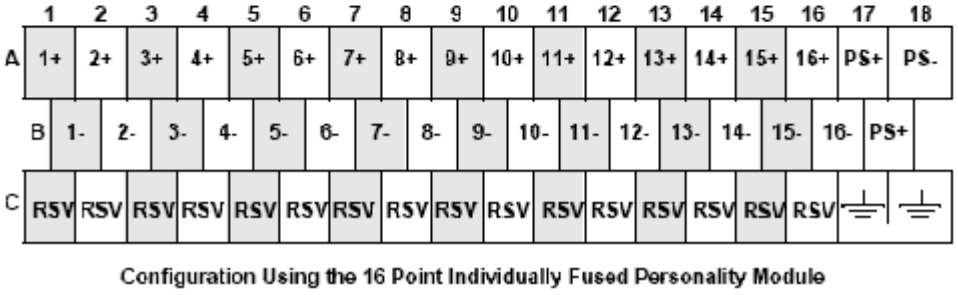
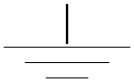

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18
A 1+ 2+ 3+ 4+ 5+ 6+ 7+ 8+ 9+ 10+ 11+ 12+ 13+ 14+ 15+ 16+ PS+ PS-
B 1- 2- 3- 4- 5- 6- 7- 8- 9- 10- 11- 12- 13- 14- 15- 16- PS+
C RSV RSV RSV RSV RSV RSV RSV RSV RSV RSV RSV RSV RSV RSV RSV RSV
Configuration Using the 16 Point Individually Fused Personality Module

Figure 144: Terminal Block Connections for the Compact Sequence of Events Digital Input Module (1C31233G01 -G03)

ABBREVIATION	DEFINITION
1+ through 16+	Digital input positive terminal connection
1- through 16-	Digital input negative terminal connection
	Earth ground terminals
PS+, PS-	Auxiliary Power Supply terminals
RSV	Reserved terminal. No internal connection

COMPACT SOE DIGITAL INPUT FIELD CONNECTION WIRING DIAGRAM (NON-CE MARK)

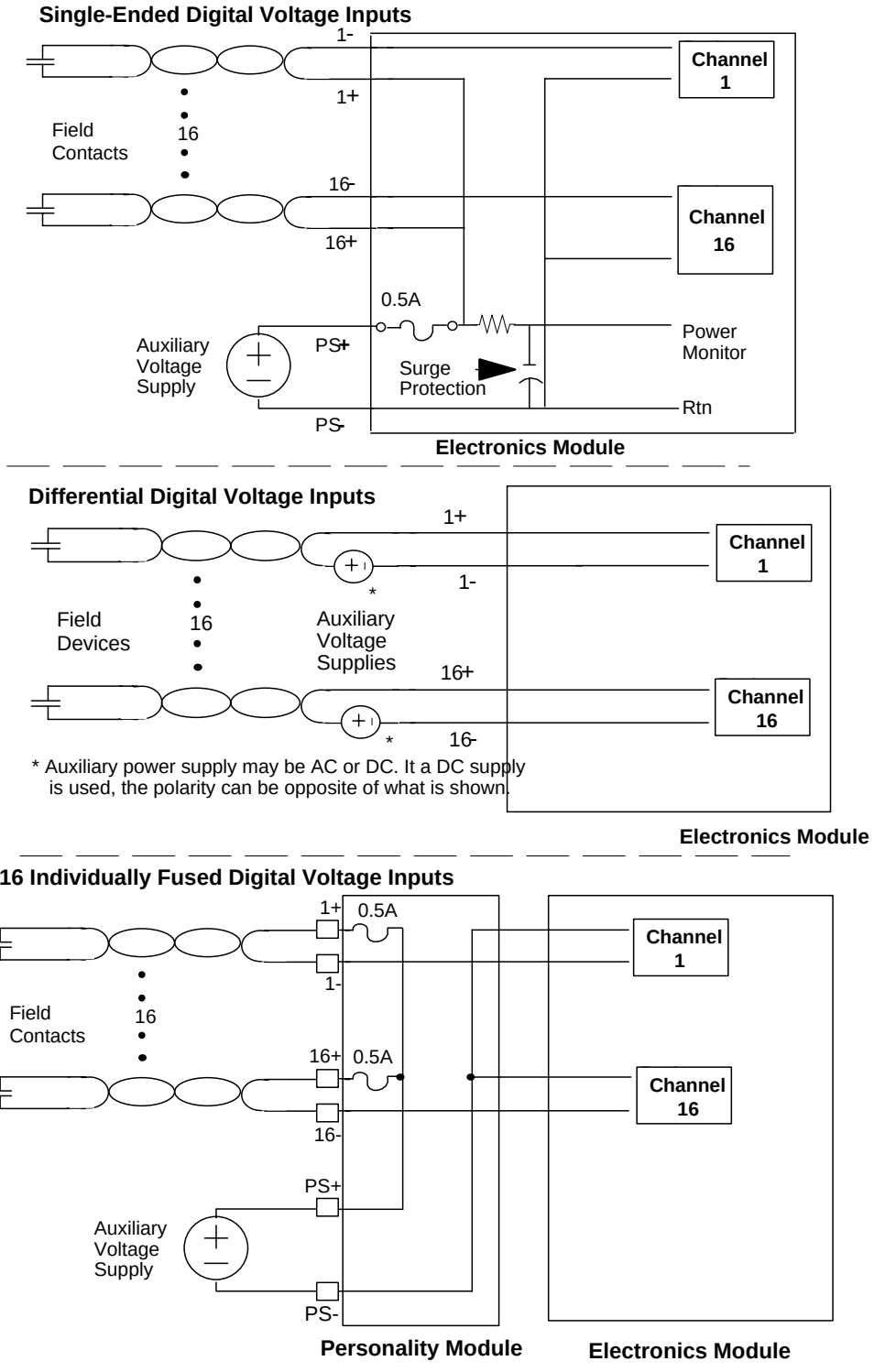


Figure 145: Field Connection for the Compact Sequence of Events Digital Input Module (Non-CE Mark)

COMPACT SOE DIGITAL INPUT FIELD CONNECTION WIRING DIAGRAM (CE MARK)

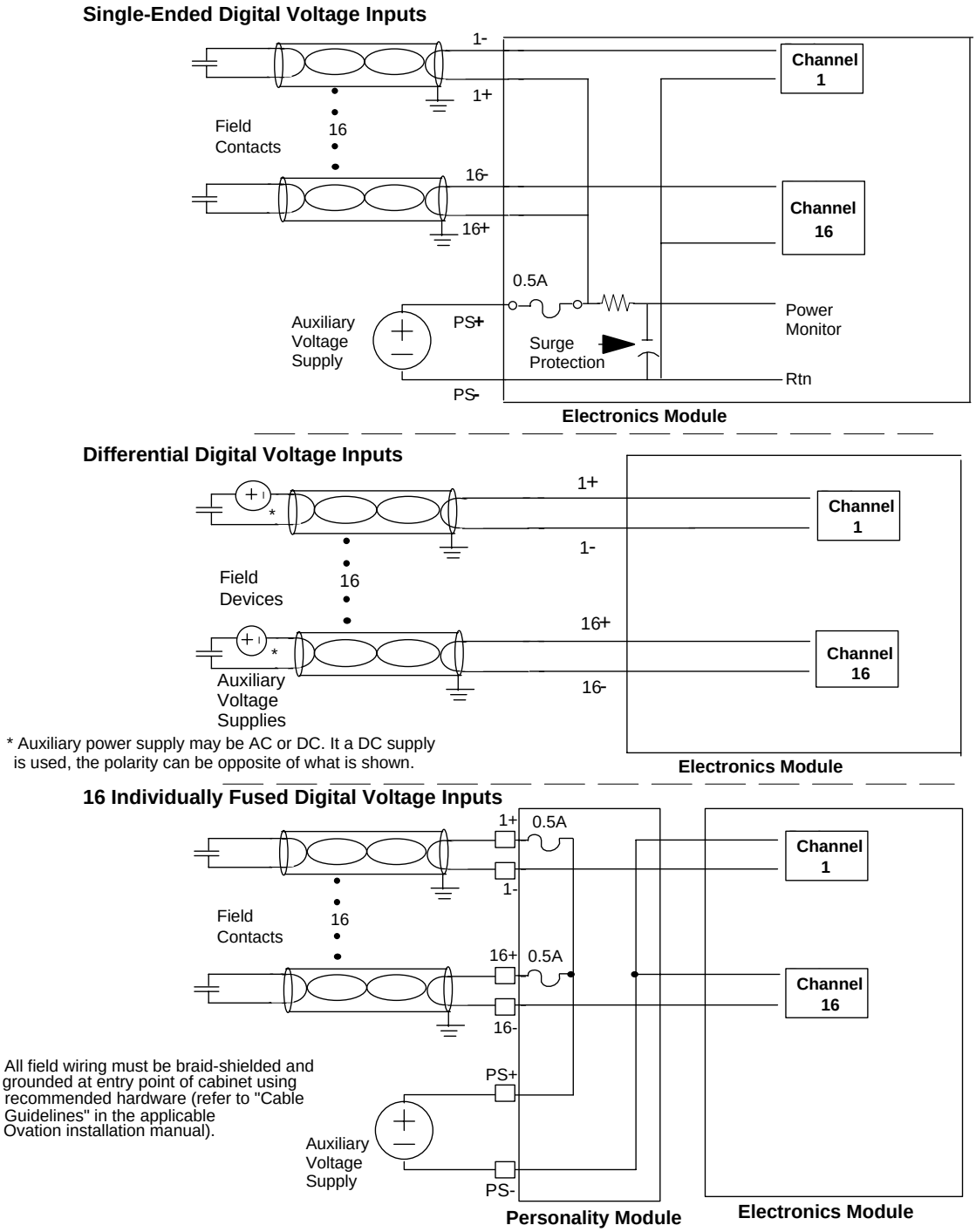


Figure 146: Field Connection for the Compact Sequence of Events Digital Input Module (CE Mark)

ADDRESS LOCATION INFORMATION

24.4.1.1.1.1 Compact SOE Digital Input Configuration and Status Register

Word address 13 (D in Hex) is used to configure the module and provide status information to the Controller. The status register can be read by using the Point Information window at an Operator Station (see the Bit Pattern Field on the Hardware Tab). Refer to the applicable "*Operator Station User Guide*" for information about the Point Information window.

Compact Sequence of Events Digital Input Configuration/Status Register (Address 13 or D in Hex)

BIT	DATA DESCRIPTION - CONFIGURATION REGISTER (WRITE)	DATA DESCRIPTION - STATUS REGISTER (READ)
0	Configure Module.	Module configured (1 = configured; 0 = not configured)
1	Force internal error.	Internal error (1 = forced error; 0 = no forced error)
2 - 5	Not used. Should be set to zero (0).	Not used.
6	Enable digital input blown fuse signal and module attention for blown fuse.	Status of enable digital input blown fuse signal and module attention for blown fuse.
7	Not used. Should be set to zero (0).	Blown fuse for digital input.
8	Contact input field card (enable contact input auxiliary voltage failure signal and module attention for auxiliary voltage failure and ground fault detection circuitry).	Status of contact input field card (enable contact input auxiliary voltage failure signal and module attention for auxiliary voltage failure and ground fault detection circuitry).
9	Not used. Should be set to zero (0).	Auxiliary voltage failure for contact input
10	Enable module attention for a GND fault.	Status of Enable module attention for a GND fault.
11	Not used. Should be set to zero (0).	GND fault.
12	Disable chatter control.	Disable chatter control.
13	Chatter control option.	Status of chatter control option.
14	Not used. Should be set to zero (0).	Clock synchronized.
15	Not used. Should be set to zero (0).	Not used.
[1] Applicable for configuration of the Digital Input module (1C31233G01 - G03).		

Bit 0: Module will not operate until this bit is set with a write.

Bit 1: When this bit is set, the internal error LED is turned on, and only the status registers can be read.

Bits 2 - 5, 7, 11, 14 - 15: Not used.

Bit 6: This bit should be set for a single-ended digital input (1C31233G01) and cleared for the others.

Bits 8 - 10: These bits should be cleared to zero (0).

Bit 12: When this bit is set and an input channel is not masked off, that input can chatter and each event will be recorded until the event buffer overflows. Default state is “0” and enables the chatter control function.

Bit 13: When this bit is set, chatter will be flagged when an input changes state four or more times between event buffer reads. When cleared, chatter will be flagged for state changes greater than 1 per 100 milliseconds.

24.4.1.1.1.2 Secondary/Expansion Configuration and Status Register

Word address 14 (E in Hex) is used to enable or disable the channel event tagging mask.

Secondary/Expansion Configuration/Status Register (Address 14 or E in Hex)

BIT	DATA DESCRIPTION CONFIGURATION (WRITE)	DATA DESCRIPTION STATUS (READ)
0 - 15	Channel Event Tagging mask	Channel Event Tagging mask

Diagnostic LEDs, Compact Sequence of Events Digital Input

Compact Sequence of Events Digital Input Diagnostic LEDs

LED	DESCRIPTION
P (Green)	Power OK LED. Lit when the +5V power is OK.
C (Green)	Communications OK LED. Lit when the Controller is communicating with the module.
E (Red)	For Single-ended Digital Input: Lit when fuse blows or there is a loss of the auxiliary power supply (Only when Bit 6 of Configuration register is set. Then Bit 7 of the Status register is set.) For Differential Digital Input: Not lit since the configuration bit is not set, and the blown fuse signal from the field card is ignored.
I (Red)	Internal Fault LED. Lit whenever the Force Error bit (Bit 1) of the Configuration Register is set, or when a timeout of the watchdog timer occurs when the Controller stops communicating with the module. Also lit when Controller stops communicating with the module.
CH1 through CH16 (Green)	Lit when the input voltage of the LED’s corresponding channel is greater than the channel’s minimum “On Input Voltage.”

24.4.2 SEQUENCE OF EVENTS CONTACT FIELD INTERFACE MODULES

Compact SOE Contact Input Field Interface

The Contact Input configuration (**1C31233G04**) provides 16 contact input current detecting channels with common returns. The field side circuitry and terminal connections for three of these channels are shown in the figure below.

A +48V on-board power supply provides current limited contact wetting voltage if the contact is open. If the contact closes, current is drawn from the +10V supply which turns on the associated opto-isolator; thereby, relaying a closed contact state to the I/O bus. The opto-isolators and the isolation provided by the 10V and 48 Volt power supply provide high dielectric isolation between the field side and the logic or I/O bus side.

There are two methods of wiring field devices to the termination block as shown in the figure below. Each field contact may have a separate input and return line as shown for channel 1. Alternatively, field contacts wired to the same module may share a return line as shown for channels 2 and 3. For either wiring method, **do not** tie the contact return line to earth ground or a ground fault condition will occur, as well as a degradation of the common mode surge protection.

Ground fault detection circuitry on the Sequence of Events module with Contact Inputs activates when the input or return line for any channel finds a low impedance (<5 K ohms) path to earth ground. A single wire with a ground fault will not cause an error in the point data, but multiple ground faults, if they include input and return lines, could cause faulty data (that is, channels appearing as if their contacts are closed when they are really open).

When a ground fault occurs, the external error LED lights, and the GND Fault bit 11 in the Status Register is set. If the GND Fault Attention Enable bit 8 is set in the Configuration Register, a ground fault is seen as a catastrophic error causing an attention status to be sent back to the Controller. See the figure below for ground fault detection circuitry.

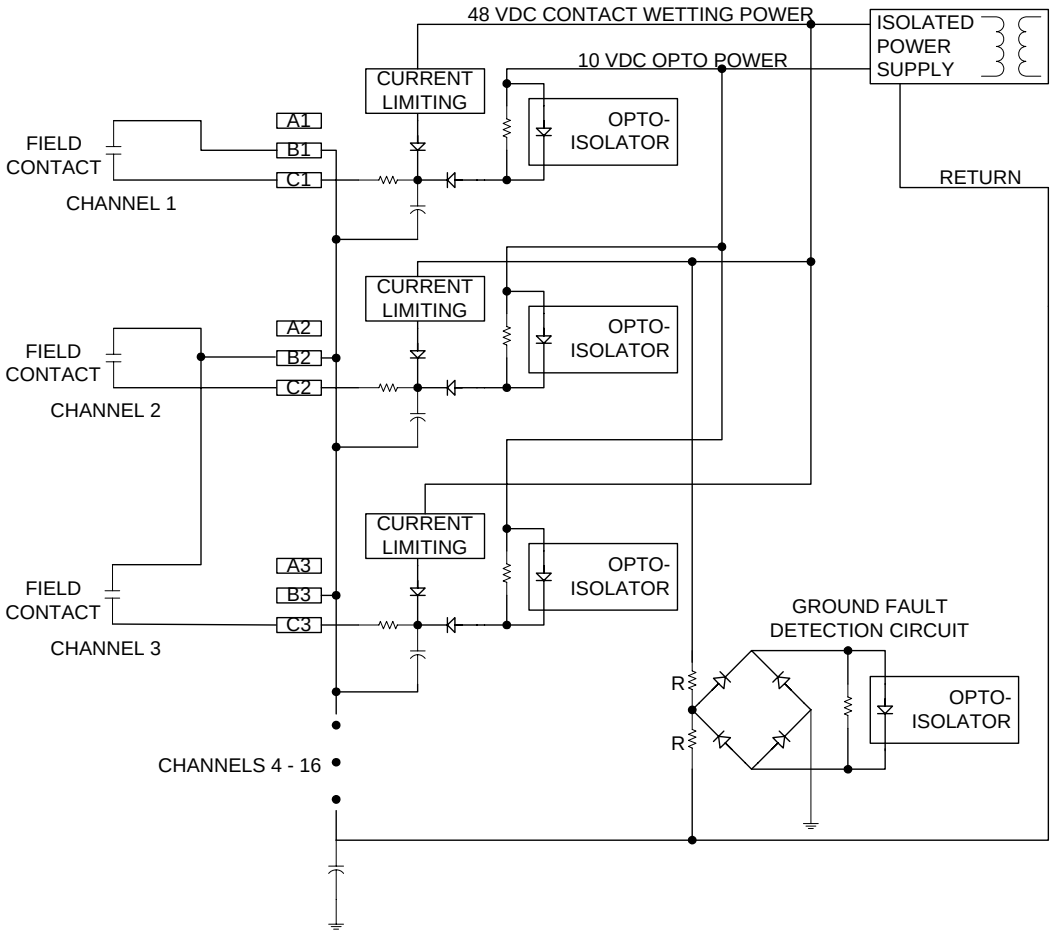


Figure 147: Compact Sequence of Events Module Contact Input Front End

Field Wiring Considerations for the Contact Input Configuration

The following definitions apply to the restrictions listed below:

- Rshunt = contact shunt resistance
- Rcontact = resistance associated with a closed contact
- Rreturn = resistance of the common return line
- Rline = resistance of the non-common cable length to and from the contact
- Rwiring = Rcontact + Rline + 16Rreturn
- Rfault = resistance from either line to ground which causes a ground fault

The figure below shows possible cable resistances that affect contact input performance. The following restrictions apply:

- Under no-ground-fault conditions or if the channel return (low) line has a ground fault:
  - Rshunt across contact must be greater than or equal to 10k ohms to always recognize an open contact as open.

- ☐ Rshunt across contact must be greater than or equal to 50k ohms to maintain the high-level contact-wetting voltage.

- If the input connection from a channel has a ground fault with the contact open:
  - ☐ Rshunt across contact must be greater than or equal to 150k ohms to guarantee ground fault is detected.
- For a ground fault on the input or return connection to a channel:
  - ☐ Rfault from either line to ground must be less than or equal to 5K ohms to guarantee detection of the ground fault.
- With or without ground fault conditions:
  - ☐ Rwiring through field wiring to contact must by < 100 ohms to always recognize a closed contact as closed.

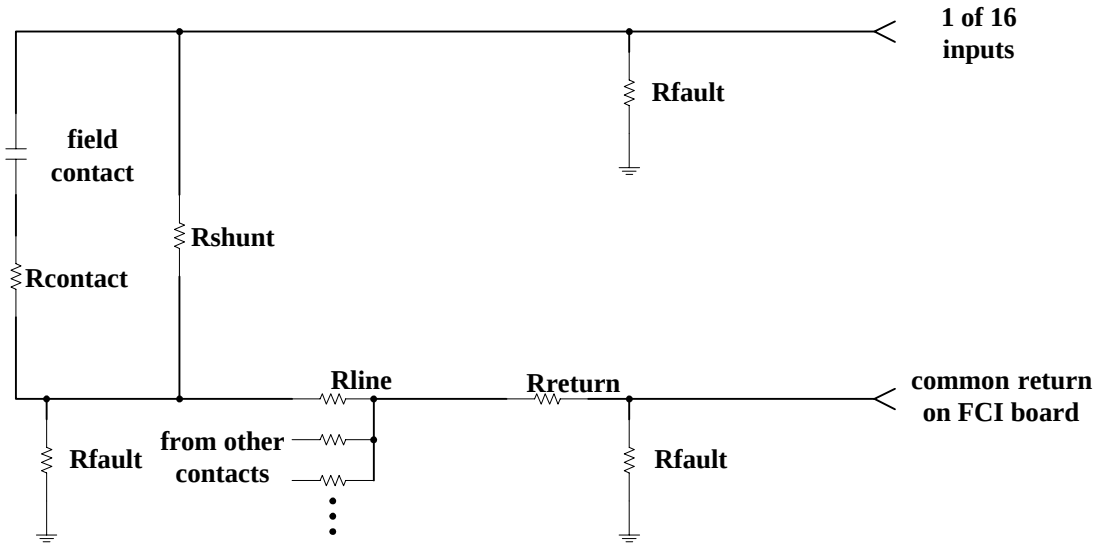


Figure 148: Cable Impedances in Field Wiring

FIELD WIRING CABLE LENGTHS

The following two tables list the maximum cable lengths for field wiring to the contacts. For both, assume Rcontact is 0 ohms.

The table below applies when there are individual common return lines brought to the card edge. This implies that Rreturn is 0 ohms.

Maximum Cable Length for 16 Individual Common Returns

WIRE GAUGE	OHMS PER THOUSAND FEET (SOLID COPPER WIRE)	MAXIMUM CABLE LENGTH(THOUSANDS OF FEET)
18	6.64	7.5
20	10.2	4.9
22	16.2	3.0

The table below applies when all 16 channels share a common return line. In both tables, the Maximum Cable Length is the length of the cables from the termination block to the contacts in the field.

Maximum Cable Length for a Single Common Return for All 16 Inputs

WIRE GAUGE	OHMS PER THOUSAND FEET (SOLID COPPER WIRE)	MAXIMUM CABLE LENGTH (THOUSANDS OF FEET)
12	1.66	3.54
14	2.27	2.59
16	4.18	1.40
18	6.64	0.89

Compact SOE Contact Input Terminal Block Wiring Information

The diagram for the Compact Sequence of Events Contact Input module is illustrated below. The following table lists and defines the abbreviations used in this diagram.

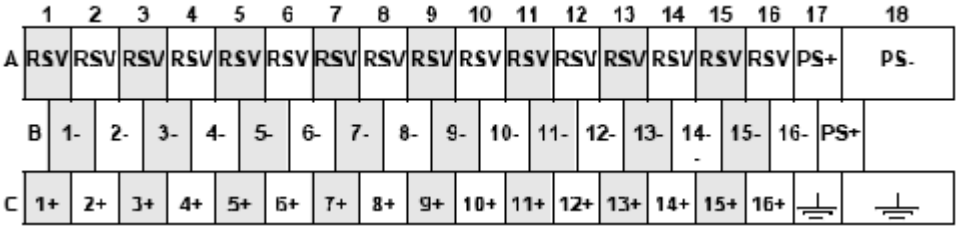
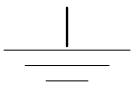
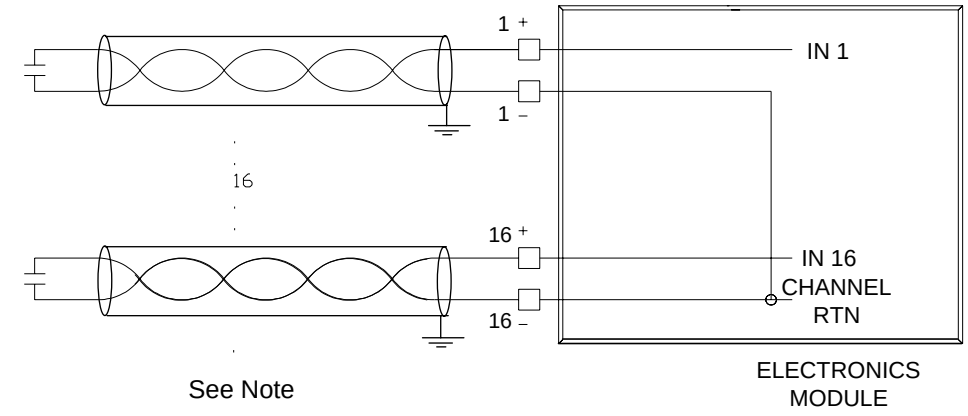


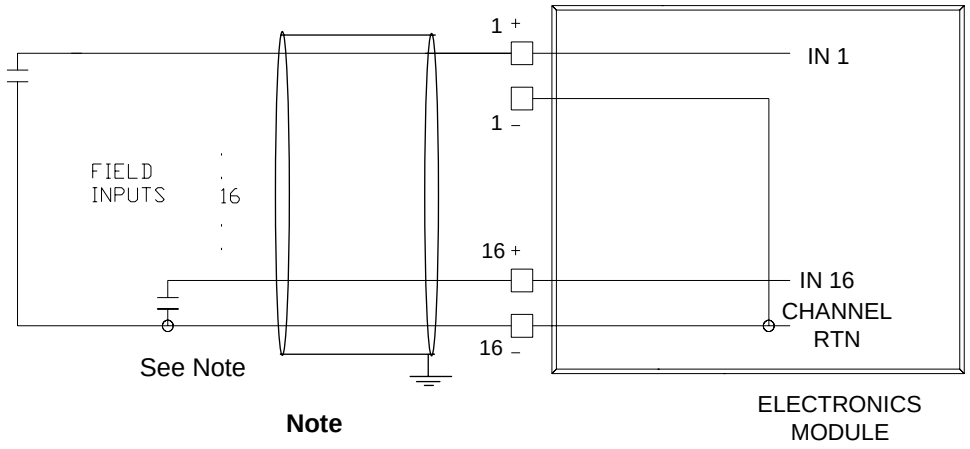
Figure 149: Terminal Block Connections for the Compact Sequence of Events Contact Input Modules (1C31233G04)

Abbreviations Used in Diagrams

ABBREVIATION	DEFINITION
1+ through 16+	Contact input positive terminal connection
1- through 16-	Contact input negative terminal connection
	Earth ground terminals
PS+, PS-	Auxiliary Power Supply terminals
RSV	Reserved terminal. No internal connection

COMPACT SOE CONTACT INPUT FIELD CONNECTION WIRING DIAGRAM (CE MARK)





Note

All field wiring must be braid-shielded and grounded at entry point of the cabinet using the recommended hardware (refer to "Cable Guidelines" in the applicable Ovation system installation manual).

Figure 150: Field Connection for the Compact SOE Contact Input Module

COMPACT SOE CONTACT INPUT FIELD CONNECTION WIRING DIAGRAM (NON-CE MARK)

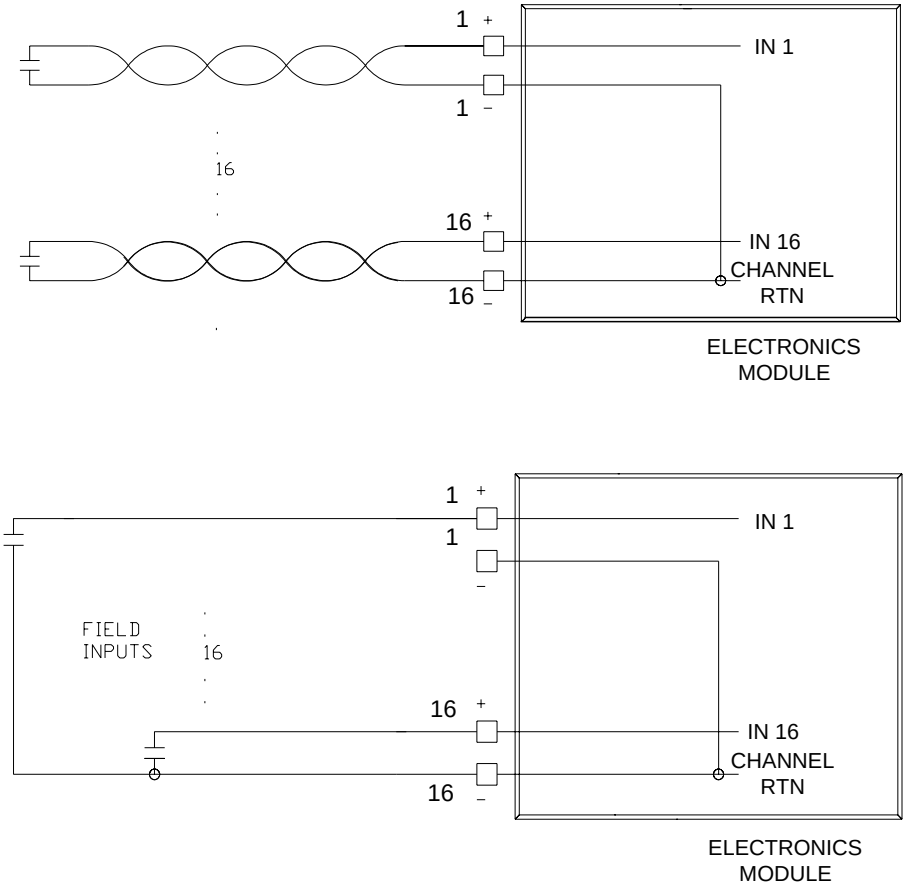


Figure 151: Field Connection for the Compact SOE Contact Input Module

ADDRESS LOCATION INFORMATION

24.4.2.1.1.1 Compact SOE Contact Input Configuration and Status Register

Word address 13 (D in Hex) is used to configure the module and provide status information to the Controller. The status register can be read by using the Point Information window at an Operator Station (see the Bit Pattern Field on the Hardware Tab). (See the *Operator Station User Guide.)*

Compact Sequence of Events Contact Input Configuration/Status Register [1] Address 13 or D in Hex)

Bit	Data Description - Configuration Register	Data Description - Status Register (Read)
0	Configure Module.	Module configured (1=configured; 0=unconfigured)
1	Force internal error.	Internal error (1=forced error; 0=no forced error)
2 - 5	Not used.	Not used.
6	Enable digital input blown fuse signal and module attention for blown fuse.	Status of enable digital input blown fuse signal and module attention for blown fuse.
7	Not used. Should be set to zero (0).	Blown fuse for digital input.
8	Contact input field card (enable contact input auxiliary voltage failure signal and module attention for auxiliary voltage failure and ground fault detection circuitry).	Status of contact input field card (enable contact input auxiliary voltage failure signal and module attention for auxiliary voltage failure and ground fault detection circuitry).
9	Not used. Should be set to zero (0).	Auxiliary voltage failure for contact input.
10	Enable module attention for a GND fault.	Status of Enable module attention for a GND fault.
11	Not used. Should be set to zero (0).	GND fault.
12	Disable chatter control.	Disable chatter control.
13	Reset chatter control counters on buffer unfreeze (instead of decrementing every 100 milliseconds).	Status of reset chatter control counters on buffer unfreeze (instead of decrementing every 100 milliseconds).
14	Not used. Should be set to zero (0).	Clock synchronized.
15	Not used. Should be set to zero (0).	Not used.

[1] Applicable for configuration of the Contact Input module (1C31233G04).

Bit 0: Module will not operate until this bit is set with a write.

Bit 1: When this bit is set, the internal error LED is turned on, and only the status registers can be read.

Bits 2 - 5: Not used.

Bit 6: This bit should be cleared to zero (0).

Bit 7: Not used.

Bit 8: This bit should be set.

Bit 9: Not used.

Bit 10: This bit should be set according to application need.

Bit 11: Not used.

Bit 12: When this bit is set and an input channel is not masked off, that input can chatter and each event will be recorded until the event buffer overflows. Default state is “0” and enables the chatter control function.

Bit 13: When this bit is set, the chatter control counter for each channel is reset each time an event buffer is unfrozen instead of being decremented each 100 milliseconds. Default state is “0” and has the chatter control counter being decremented every 100 milliseconds.

Bits 14 - 15: Not used.

24.5 DIAGNOSTIC LEDS

The following table lists the module’s LEDs and describes what they mean when lit.

Compact Sequence of Events Contact Input Diagnostic LEDs

LED	DESCRIPTION
P (Green)	Power OK LED. Lit when the +5V power is OK.
C (Green)	Communications OK LED. Lit when the Controller is communicating with the module.
E (Red)	External fault. Lit when a ground fault occurs in the field wiring. Ground fault is also indicated in bit 12 (GND fault) of the Status register.
I (Red)	Internal fault. Lit when the internal on-card +48V/+10V contact auxiliary power supply has failed. Only lit if Bit 8 of the Configuration register is set.
CH1 through CH16 (Green)	Lit when the input contact of the LED’s corresponding channel is closed.

24.6 SPECIFICATIONS

Compact SOE Contact Input Module Emod (1C31233G04)

Compact Sequence of Events Contact Input Module Specifications

DESCRIPTION	VALUE
Number of channels	16
On board auxiliary power supply	42 V minimum 55 V maximum
Signal rejection Always rejects contact change of state Always accepts contact change of state	 < 3.87 mSec > 4.13 mSec
Propagation delay of contact change of state [1]	3.75 mSec minimum; 4.4 mSec maximum

DESCRIPTION	VALUE
Closed contact output current	4 mA minimum 8 mA maximum
Diagnostics	Internal module operating faults Ground Fault Detection
Dielectric isolation: Channel to logic	 1000 VAC
Module power from logic supply	4.56 W typical (all inputs on) 5.0 W maximum
Operating temperature range	0 to 60°C (32°F to 140°F)
Storage temperature range	-40°C to 85°C (-40°F to 185°F)
[1] Does not include cable capacitance.	

SECTION 25

SERVO DRIVER MODULE

IN THIS SECTION

Description *373*
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Module Groups *375*
Module Specific Information *376*
Wiring Information *394*
Address Location Information *399*
Diagnostics *403*
Diagnostic LEDs *404*
Specifications *405*

25.1 DESCRIPTION

Steam turbines are used in many electrical power generation plants. The electrical load on a steam turbine's electric generator fluctuates as the electric power consumption increases or decreases. The Digital Electro-Hydraulic (DEH) control system provides turbine control to adjust steam turbine shaft rotational speed in response to varying electric generator loads. Very large amounts of force are required to move valves on large turbines. Therefore, an interposing device is required between the DEH control system and the controlled valves.

The Ovation Servo Driver module provides an interface between an Ovation Controller and an electro-hydraulic servo valve actuator. Each controlled turbine valve is connected to an electro-hydraulic actuator (servo-motor). A servo-motor is a fluid operated piston. Admission of high pressure hydraulic fluid to the piston cylinder is regulated by a smaller pilot valve. The pilot valve passes hydraulic fluid underneath the piston to raise it and the controlled valve, or it diverts hydraulic fluid to the upper side of the piston to lower it and the controlled valve.

A valve position set point is maintained by the Ovation Servo Driver Electronics module. The set point is normally altered by the Ovation Controller via the I/O bus. Inside the Electronics module, a microcontroller provides closed loop proportional-plus-integral (PI) control for real time valve position control.

Note: *I/O Module General Information (see page 15) contains environmental, installation, wiring, and fuse information for I/O modules. The firmware level for the Servo Driver module must be* ***Version 0B*** *or later.*

The valve position set point causes the Servo Driver module to generate an output control signal that drives the electro-hydraulic servo valve actuator coil. The feedback loop is closed with the valve's position measurement being obtained from a DC-LVDT or an AC-LVT that is mounted on the valve stem.

The electronics module will interface two Electro-Hydraulic (EH) actuators in the field. The module provides two independent channels that are electrically isolated from each other.

25.2 OPERATION

The Servo Driver module operates as a two-channel closed-loop servo card, or as a single-channel closed loop servo card that accommodates dual LVDTs. A configuration flag is set/reset to select the option.

The dual-channel option uses a single sine-wave or DC feedback to detect valve position for each channel. The feedback signal's amplitude is proportional to valve position. A programmable gain amplifier is used to increase the resolution of the feedback signal and is adjusted for optimum performance during a calibration sequence.

Starting with revision 0C, RSR firmware supports a cascaded PI configuration in which the output of PI 1 is used as the target position input for PI 2. Additional features to support cascading operation are flags to select direct/indirect PI operation, and an anti-windup feature called "retreat." Some of these new features are actually independent of cascading, but all are described in detail in this document.

When a sine-wave input is used as the feedback, it is assumed that the feedback signal provided is proportional to valve position, and linear. The sine-wave input is rectified and the result is uni-polar. The input can accommodate a signal of increasing or decreasing amplitude as the valve is stroked from 0 to 100%. Depending on the customer mechanical hookup, a failed signal would then appear to the card as a valve flying open, or a valve flying closed, and the resulting control action would be to close the valve or to open the valve.

The single channel option executes only one PI loop in the microcontroller firmware. Prior to executing the PI loop, the feedback positions from each channel are high selected.

Another option is the "failInPlaceFlag" option. If the option is set and the Controller stops updating the module, the target position remains at the most recent position. If the "failInPlaceFlag" option is not set, the target position is set to -5%.

Another important option is the proportional output option. If this option is selected, the output voltage is set equal to demand position. The result is that 0 to 100% demand gives 0 to 10.2 volts on the output.

The proportional output, failInPlaceFlag, and redundant LVDT options are single flags that affect both channels.

25.2.1 AD/DA CONVERSION AND TIMING

The Servo Driver operates on a basic 5 millisecond period. During the 5 millisecond period, four interrupts occur. During each of the first three interrupts, AD readings of position feedback are recorded for each channel. After the third AD reading is taken, the three values are middle-selected and the PI algorithm is called.

The fourth interrupt in the 5 millisecond period handles watchdog timing, contingency timing, and sequencing of diagnostics.

25.3 MODULE GROUPS

25.3.1 ELECTRONICS MODULES (EMODS)

There are three Electronics module groups for the Servo Driver module:

- 1C31199G01 provides 16 Volts DC to a DC LVDT.
- 1C31199G02 provides 19 Volts AC peak-to-peak 1 KHz to an LVT.
- 1C31199G03 provides 19 Volts AC peak-to-peak 3 KHz to an LVT.

25.3.2 PERSONALITY MODULES (PMODS)

There are two Personality module groups for the Servo Driver module:

- 1C31201G01 has an RJ-45 modular jack to provide access to a local RS-232 serial port. Both field interface channels contain three resistors connected in series that are used to provide a single coil drive output.
- 1C31201G02 has an RJ-45 modular jack to provide access to a local RS-232 serial port. Both field interface channels contain two coil drive outputs, each output with its own series resistor.

25.3.3 SUBSYSTEMS, SERVO DRIVER

Servo Driver Subsystems [1]

RANGE	CHANNELS	ELECTRONIC MODULE	PERSONALITY MODULE
±16 Volts DC to a DC LVDT 60 mA into a 60 ohm coil (CD1) or 40 mA into an 80 ohm coil (CD2) or 40 mA into a 40 ohm (CD3) coil	6	1C31199G01	1C31201G01
19 Volts AC peak-to-peak 1 KHz to an AC LVT 8 mA into two 1000 ohm coils	6	1C31199G02	1C31201G02
19 Volts AC peak-to-peak 3 KHz to an AC LVT 8 mA into two 1000 ohm coils	6	1C31199G03	1C31201G02

When using the Point Builder to define points for a Servo Driver module, only the following point types are valid for each channel:

I/O Channel	Name	Type	Input Source or Output Destination	Terminal Block Connection[2]
1	Position Feedback (Device 1)	Input	Servo Driver	N/A
2	Position Feedback (Device 2)	Input	Servo Driver	N/A
3	Raw Demodulator Voltage (Device 1)	Input	Servo Driver	N/A
4	Raw Demodulator Voltage (Device 2)	Input	Servo Driver	N/A
5	Demand (Device 1)	Output	N/A	N/A
6	Demand (Device 2)	Output	N/A	N/A

[1] This module will interface to, and provide position control for two Electro-Hydraulic (EH) actuators in the field.

[2] The terminal block connection depends upon the application being used. Refer to wiring diagrams.

25.4 MODULE SPECIFIC INFORMATION

25.4.1 SERVO DRIVER MODES

The Servo Driver operates in various modes:

- Start mode
- Normal mode
- Local-Manual mode
- Calibrate mode

Start Mode

In **start** mode, the following occurs:

- Feedback position is determined.
- Diagnostics are executed.
- The module will typically transition into normal mode immediately.

  If the module does not transition to normal mode, the user can determine the reason by examining register E, which contains SFEs, or by using a laptop to enter the “diag**”** command and print diagnostic information.

When the Servo Driver is powered-up or restarted, its primary objective is to avoid an indeterminate output that would result in valve movement and possible damage to the valve or turbine. There are a number of hardware and software features that prevent an indeterminate output.

The hardware is designed so that when the Servo Driver is powered-up, the power supply to the servo output is turned off. With no current flow to the servo valve, it is left under the influence of its mechanical bias adjustment, the assumed state prior to power-up. In addition, the coil drive D/A converter is not turned on until it receives the first output pattern.

As part of the microcontroller's start sequence, the power supply is turned on, and then a pattern is written to the coil drive D/A converter representing 0 volts. The result is that the servo output is under software control, no current flows between the Servo Driver and the servo valve, and no valve movement has occurred.

The Servo Driver will not remain in Start mode unless a diagnostic error is detected. The Servo Driver transitions from Start to Local mode if all of the following functions execute and return "normal" or "ok" status codes:

- Program the FPGA.
- Initialize default PI constants.
- EPROM checksum check.
- Read out configuration constants from EEPROM.
- Go to Factory Configure Mode if PE pin is 1.
- EEPROM checksum check.
- RAM read/write test.
- UART scratchpad read/write test.
- Shared memory readback check.

The Servo Driver will set target valve demand equal to demand feedback before transferring to Local mode.

Normal Mode

In **normal** mode, the following occurs:

- Servo Driver moves the valve to the position requested by the Controller.

Note: *Normal is the preferred mode of the Servo Driver card.*

Local-Manual Mode

Local-manual mode is a transition mode used if the Controller is required to track valve position on startup. In the Servo Driver module, there is no requirement for tracking. Local-manual mode is a transition mode with no restrictions to normal mode.

Local-manual mode is also used for calibration sequences.

Calibrate Mode

Calibrate mode is a submode of local-manual mode. Calibration sequences are commanded from the Controller or through the local serial port.

The Servo Driver is calibrated by entering a command through a personal computer connected to the local serial port.

The following calibrate sequences are supported:

- Zero Hot Cal

  This calibration sequence is executed to re-establish the 0% position. It is useful after the valve has been fully calibrated and the mechanical assembly has been heated and expanded. It avoids fully opening the valve.

  Feedback gain is not adjusted during the hot cal sequence.

- Top Hot Cal

  This calibration sequence is executed to re-establish the 100% position. It is useful after the valve has been fully calibrated and the mechanical assembly has been heated and expanded. It avoids fully closing the valve.

  Feedback gain is not adjusted during the hot cal sequence.

- Full Calibration

  This calibration sequence is executed to re-establish 0% position, 100% position, and feedback gain.

  Arbitrary limits are established for the full calibrate sequence. A valve with an 8 inch stroke that can expand by 1/8 inch is envisioned. For this valve, thermal expansion is 1/64 or 1.5%. Since the A/D converter range limit is +/- 10.4 volts the limit at 100% is arbitrarily set at 10.0 volts, or 2% of the electrical range from the end of the converter range. The target range for 100% when adjusting gain is 9.9 volts to 10.0 volts.

  When full calibration is requested, the valve first travels to 0%. At 0%, demodulator gain is adjusted until the feedback voltage is near 10 volts. The demodulator gain at this point is the maximum possible demodulator gain.

  Then, the valve travels to 100%. If the voltage is greater than 10 volts, or off-scale, demodulator gain is reduced, and a reading of the voltage is taken. This reading is the 100% calibration valve.

  Then, the valve travels to 0% and a voltage reading is taken. This reading is the 0% calibration value.

  After the 0% calibration valve is determined, the new values are written to EE memory.

25.4.2 Using the Serial Port for Calibration, Settings

The local serial port is used in the field to calibrate and diagnose Servo Driver problems. It is used in the factory to cause the Servo Driver to perform necessary testing prior to shipment. This interface is implemented using the external UART.

The settings of the local serial port are:

- Baud rate = 192000
- Bits = 8 bits
- Stop Bits = One stop bit
- Parity = No parity

Any of the commands in Calibration Procedure (see page 381), and Tuning Constant Commands (see page 389) can be entered through the local serial port.

Commands to change constants and initiate calibration sequences always refer to channel 1 or channel 2. The command **CH=1** or **CH=2** selects the channel.

Once the channel is selected, it is indicated by a prompt character sequence, such as:

```
*1*>
```

OR

```
*2*>
```

Status messages are printed during calibration sequences and indicate the channel number (or valve number), such as:

```
'V1-Calibrate - Go to 100%'
```

OR

```
'V2-Calibrate - Reduce feedback gain'
```

25.4.3 Using the Serial Port for Calibration, Connections

The Personality module RS-232 connector is used to connect the Servo Driver module to the COM1 or COM2 serial port of a personal computer.

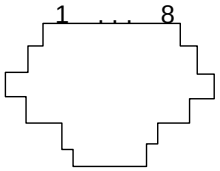
Use cable **5A26448** or make a cable using the information.

RS-232 Connector (RJ45) Pin Assignments

Pin Number	Signal Name (Function)	Signal Direction
1	Not used	Not used
2	Not used	Not used
3	TXD2 (Transmit Data)	Output
4	Not used	Not used

PIN NUMBER	SIGNAL NAME (FUNCTION)	SIGNAL DIRECTION
5	RXD2 (Receive Data)	Input
6	GND (Logic Common) 1	Not used
7	Not used	Not used
8	Not used	Not used

Front View of RJ45 Connector (Modular Jack)



1 This serial port is not electrically isolated from logic common.

25.4.4 PERFORMING CALIBRATION

Calibration is performed by connecting a PC (running terminal emulation software) or a dumb terminal to the Servo Driver, then typing commands on the PC keyboard or terminal. Using a PC is recommended because you can record/reload tuning constants to/from a disk.

The goals of calibration are:

- To determine the endpoints of mechanical stroke.
- Help the plant set up the LVDT for optimum performance.
- Perform the calibration quickly to avoid startup delay.

Calibration Required

Calibration is required after the following:

- After a mechanical overhaul.

  If the mechanical stroke remains the same after the overhaul, and the same LVDT is installed, simply adjust the LVDT so the position feedback on the Ovation system indicates 0% (with the valve fully closed), then tighten down the LVDT assembly (that is, return to its former position).

- After the LVDT is changed.

  Calibration is required to find the null point and proper demodulator gain adjustment. However, if it is the same model, time can be saved by entering the same constants before running the calibration sequence.

- If a secondary wire pair is swapped.

  The valve positioner is not affected because the demodulator is a diode rectifying type. Also, the secondary pairs (A and B), can be swapped. The result will be a change in sign of the calibration values. Arithmetic in valve positioner firmware will yield the correct result. However, the user should follow the recommended hookup that will yield negative values at 0% and positive values at 100%, and avoid confusion.

Calibration Procedure

1. Use a standard cable to make the connection (see page 379) between the PC (or dumb terminal) and the Servo Driver.
2. Configure the serial port on the PC as described in “Settings (see page 379).”
3. To run a calibration sequence, perform the following:
   a) Connect a serial cable between the COM port and the user port on the Servo Driver.
   b) Start the terminal emulation software.
   c) Ensure the settings are correct.
   d) Type **HELP**<**return**> at the prompt to see a list of commands (described in the table below).

   Note the following:

   - ☐ Commands are case sensitive.
   - ☐ Syntax is strict.
   - ☐ There is no line buffering.
   - ☐ Backspace invalidates any typed command.
4. Type **CALFULL**<**return**> to run the full calibration sequence.
5. If any constants are entered manually, type SC<**return**> to save the new constants to the EEPROM.
6. Use the command **CALFULL** after an overhaul, to fully calibrate the valve.
7. Use the command **CALBOT** just prior to startup, to re-establish the 0% calibration value if thermal expansion is detected.

Calibration Commands

COMMAND	DESCRIPTION
CALBOT<return>	Calibrate zero%
CALTOP<return>	Calibrate 100%
CALFULL<return>	Full Calibration
RAISE<return>	Raise (automatically switches card to local mode) (Hit <return> to repeat.)
LOWER<return>	Lower (automatically switches card to local mode) (Hit <return> to repeat.)
DC<return>	Dump configuration constants from EEPROM.

COMMAND	DESCRIPTION
SC<return>	Save configuration constants to EEPROM.
DG<return>	Display group 1 data - This function would repeatedly display important operating parameters such as demand, feedback, gain, and so forth.
HELP<return>	Displays a command list.
EXIT<return>	Exits test mode. raise/lower function, or calibration sequence. Causes a soft reset of the valve positioner.

Calibration Ideal

During the calibration sequence, observe the valve to ensure it is moving, and that it is moving in the proper direction. Also, review the calibration constants and compare them with the ideal setup described below:

- The range of calibration values corresponds to the hexadecimal range of the AD converter, and is presented to the user in decimal, ranging from -31768 to 31767.
- When an LVDT is properly adjusted and calibrated, the calibration constants (0% and 100%) will be equal in amplitude and opposite in sign. The amplitudes for this ideal setup would be approximately 30,000. This result suggests the following:
  - The LVDT is adjusted so that its electrical null point (where secondary A amplitude = secondary B) matches the midpoint of the mechanical stroke.
  - The programmable gain amplifier on the demodulator is adjusted so that the electrical “stroke” stays within the input range of the AD converter. Thus, the valve positioner can detect incremental movement for all valve positions.
  - If thermal expansion occurs, the valve positioner will continue to detect incremental movement because the calibration is not to the extreme end of the AD converter range, and because the magnitude of thermal expansion is small.

Simplify Diagnostics

Rolled servo wires can cause the valve to move in the opposite direction. Be sure to observe and verify the correct movement of the valve. If only one pair is rolled, then the two pairs will be “fighting” each other. Use the following procedure to simplify diagnosis:

1. Disconnect one pair of wires.
2. Calibrate the valve, verifying the correct movement of the valve.
3. Reconnect the first pair of wires.
4. Disconnect the other pair of wires.
5. Calibrate the valve, verifying the correct movement of the valve.
6. Reconnect all the servo wires.
7. Calibrate the valve, verifying the correct movement of the valve.

On-Board Diagnostics

The mechanical bias adjustment of the servo valve can affect the results of on-board diagnostics. A set-screw on the servo valve causes a deflection from center position of the servo valve spool. This allows hydraulic fluid to escape the actuator, and the valve to close at controlled rate, in the absence of an electrical signal.

For a typical hookup, a small negative voltage on the servo valve is required to center the spool, and hold the valve in a steady position. This voltage is typically from -100 to -300 mV. Servo valves are delivered from the factory with this adjustment. On board diagnostics assume that the servo valve is set up in this way. If another setup is used, program the Ovation Controller to ignore the results of diagnostic bits.

Setting Up Redundant LVTs

During redundant LVT operation, only one software PI is executed. The output voltage is written to both DACs. Therefore, there are four identical servo output voltages. By connecting one coil to channel 1 and the other to channel 2, you can take advantage of duplicate DAC and output driver hardware.

1. In order to set up the Servo Driver for redundant LVT operation, enter the command

   RDNDNT=1

2. Save the configuration flag to EEPROM by using the command

   SC <return>

3. Once the wires are hooked up properly, calculate the valve by typing

   CALFULL <**return**>

   During the calibration, the channel undergoing calibration is indicated on the terminal screen.

Calibrating Redundant LVTs

Calibrating redundant LVTs on the Serve Driver is difficult because improper setup can create a situation where the feedbacks from the LVTs indicate that the valve should be moved in the opposite direction. Then, during the calibration sequence, the valve will not move to the endpoint properly and record valid data. Another complicating factor is that in the redundant configuration, the position feedbacks are high-selected.

The servo driver is a two-channel Controller. Each channel is calibrated independently. The channel to be calibrated is selected by typing one of the following:

V1 to select valve 1

OR

V2 to select valve 2.

During the calibration, all the printed messages will indicate the valve number.

Once all the wiring is properly connected, it is possible to calibrate the Servo Driver with the redundant flag set to **1**. In this situation, the channel not being calibrated will simply follow along with the channel under calibration.

For initial calibration, after an overhaul, or for a new installation, it is recommended that you clear the redundant flag and calibrate each LVT independently. During this process only one servo coil would be connected because the independent channels will “fight” each other. The calibration process follows:

1. Clear the redundant flag by typing **RDNDNT=0**<return>, then save the setting to EEPROM.
2. Disconnect the second servo coil, leaving one servo coil connected to channel 1.
3. Calibrate channel 1.
4. Disconnect the servo coil connected to channel 1.
5. Connect the other servo coil to channel 2 servo coil output.
6. Calibrate channel 2.
7. Connect servo coil to channel 1.
8. Set the redundant flag and save setting to EEPROM.

25.4.5 VALVE POSITION CONTROL

In normal, local, and calibrate modes, the Servo Driver is always controlling valve position. The PI routine runs unconditionally every 10 milliseconds. Typically, it will execute the PI equation as described below. The PI routine has some conditionally executed parts to handle seating and backseating.

Seating, Backseating, and Retreat

Seating and BackSeating are similar functions, with the exception that Seating closes the valve, and BackSeating opens it. Therefore, only Seating is described.

Retreat is an anti-windup function. It is important to remember that when the RSR servo output is near 0 volts, the valve is stationary. When the servo output moves away from the midpoint, the valve moves to the desired position, and the servo output goes back to near 0 volts.

Retreat is a feature that occurs after Seating. It is highly programmable.

When the target position is less than seat limit, the RSR goes into a seating mode. In this mode the RSR wants to close the valve as fast as possible. It accomplishes this by driving the output hard to the rail in the direction of valve closure.

Retreat occurs after a timer has expired (retreatHoldT), and once the valve position is close to where the RSR wants it to be (ABS|Target-Feedback| < posErrorRetreat). When a valve retreats, the servo output goes from the rail to a programmed value (exitSeatVal) at a predefined rate (retreatRate).

In a typical scenario, the user would determine the voltage required to null the servo spool; that is, overcome the mechanical bias adjustment. Let's assume the value is –200 mV. The user would then set exitSeatVal to –200 mV plus an arbitrary amount in the direction of valve closure, 100 mV perhaps. So, the user would set exitSeatVal to –100 mV. Also, assume the user leaves the other associated constants to their default values. When seating is entered, the servo output goes to +10 volts and will remain there for at least 10 seconds. When the 10 second timer expires, and when position feedback is within 2 percent of the target position (probably 0), the servo output ramps from 10 volts to –100 mV at 10% per second. Ten volts is about 50% of output range, so the servo output would return to –100 mV after 5 seconds. At –100 mV, the servo spool is letting a small amount of fluid escape, thus closing the valve.

If the target position went higher, thus removing the RSR from seating, the servo output would be readily available to begin to move the valve, and would not rely on integral action to bring it from 10 volts back to 0.

When the RSR is moving between these various modes, the PI tracks the output when it is begin driven by one of the non-normal modes such as seating. Therefore, the transition back to normal operation is bumpless.

If the system is not properly tuned, the valve could start to go open when the servo output reaches the retreat value. If this occurs and ABS|Target-Feedback| > posErrorRetreat, a bit is set in register D to announce the condition. The RSR sends the output back to the rail and will not allow the channel to retreat again until seating is exited. The user should ensure that the bits in register D generate alarms to notify the operator should this occur.

PI Position Control

The equation for PI position control is:

$$K_p\left[e(t)+\frac{1}{k_i}\int e(t)dt\right]$$

where:

K^p = Proportional gain

K^I = Integral time

e(t) = Position error

If seating or backseating is in effect, normal PI Controller calculation is halted.

Cascading of the PI controllers can be selected by entering "**CASCADE = 1**" and saving the setting by typing "**SC**".

When cascading is selected, the +100% to -100% output of PI 1 is converted to -100% to 0% target position. This target position value is then used as the target position, or demand, for PI 2.

25.4.6 CONTROLLER INTERFACE

The following topics defines direct-access Ovation shared memory registers from the Controller point-of-view. The Servo Driver configuration allows I/O points to be defined. These I/O points are configured as standard Ovation hardware points. There is no special algorithm interface with the Servo Driver.

Serial Bus Watchdog Timer

The timeout value for the Servo Driver module is selected in the I/O Builder Servo Driver configuration dialog box (described in the appropriate "*Ovation I/O Builder User Guide*" or "*Ovation Developer Studio*" information for your system). Make sure this time period value is **greater than** the value of the Control Task time period that defines the points associated with this module.

Bits 2, 3, and 4 of the configuration register (register D) determine the length of a watchdog timer. The 3-bit codes and associated times are standard for Ovation I/O.

Initially, the timer is set to the maximum time, which is 16 seconds. The microcontroller periodically reads the configuration register and determines the timeout time.

If the timer expires, the Internal Error LED bit is set, and the LED is turned on. The Communications OK LED is extinguished. As long as the timer is not expired, the Communications OK LED is illuminated and the Internal Error LED bit is cleared.

MEMORY MAP

The following table describes the Controller register for the Servo Driver module and defines the I/O Channel Number that must be selected in the Point Builder Hardware Tab (shown below) when configuring points associated with this module (refer to the appropriate "*Ovation Point Builder*" or "*Ovation Developers Studio User Guide"* for your Ovation system).

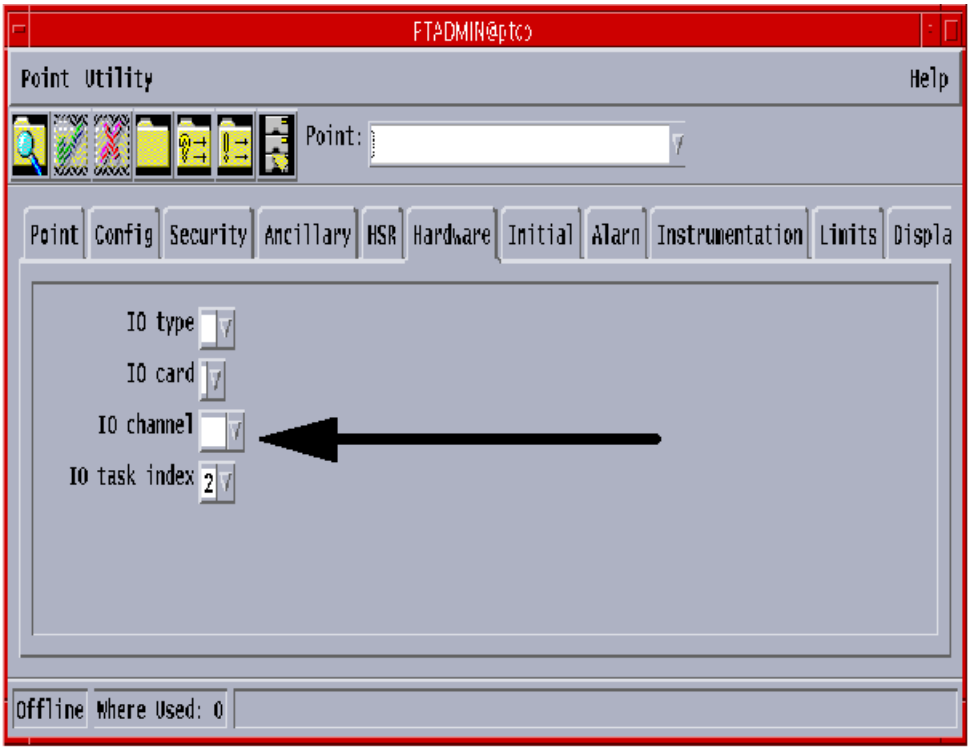


Figure 152: Example of Hardware Tab in Point Builder

Operating Mode Memory Map

SERVO DRIVER CARD REGISTER	I/O CHANNEL NUMBER IN THE POINT BUILDER	R/W	DEFINITION
0	N/A	N/A	Indirect ram pointer (Output FIFO Put Pointer)
1	N/A	N/A	Indirect ram data register
2	5	W	Demand - Channel 1 (-1560 to 32760 equals -5.0 to 105.0%)
3	6	W	Demand - Channel 2 (-1560 to 32760 equals -5.0 to 105.0%)
4	1	R	Position feedback - Channel 1 (-1560 to 32760 equals -5.0 to 105%)
5	2	R	Position feedback - Channel 2 (-1560 to 32760 equals -5.0 to 105%)

SERVO DRIVER CARD REGISTER	I/O CHANNEL NUMBER IN THE POINT BUILDER	R/W	DEFINITION
6	3	R	Raw demodulator voltage - channel 1 (standard format where +/-0xFFF (bit 12 is sign, +0xC000) equals +/- 10.235 volts)
7	4	R	Raw demodulator voltage - Channel 2 - same format as Channel 1
8	N/A	R	Status Word 1 **Bits 0 through 3** - modes for Channel 1 0000 - not used 0001 - PE mode 0010 - start mode 0011 - test mode 0100 through 0111 - not used 1000 through 1011 - local modes 000 - local mode 1001 - calibrating in local - seated 1010 - calibrating in local - backseated 1011 - calibrating in local 1100 through 1111 - normal modes 1100 - normal mode 1101 - calibrating in normal - seated 1110 - calibrating in normal - backseated 1111 - calibrating in normal mode **Bit 4 and Bit 5** - not used **Bit 6** - calibrate jumper **Bit 7** - Servo Driver alive flag (The Controller echoes this bit back to the Servo Driver via the command register in order to indicate the Controller is operating normally.)
8	N/A	R	**Bits 8 through 11**- modes for Channel 2 0000 - not used 0001 - PE mode 0010 - start mode 0011 - test mode 0100 through 0111 - not used 1000 through 1011 - local modes 1000 - local mode 1001 - calibrating in local - seated 1010 - calibrating in local - backseated 1011 - calibrating in local 1100 through 1111 - normal modes 1100 - normal mode 1101 - calibrating in normal - seated 1110 - calibrating in normal - backseated 1111 - calibrating in normal mode **Bits 12 through 15** - not used
9	N/A		Not used

SERVO DRIVER CARD REGISTER	I/O CHANNEL NUMBER IN THE POINT BUILDER	R/W	DEFINITION
A	N/A	W	Command Register **Bit 0 through 5** - not used **Bit 6** - Controller alive flag (blind copy of status word 1 bit 7) **Bits 7 through 15** - not used
B	N/A		Not used
C	N/A		Reserved
D	N/A	R/W	Module Configuration Status Register (see page 399)
E	N/A	R	Severe Errors Status Register (see page 401)
F	N/A		Electronic ID

25.4.7 SERVO DRIVER COMMANDS

Tuning Constant Commands

The following commands are used to set the values of important tuning constants. The syntax of each command is indicated and must be followed.

Tuning Constant Commands

COMMAND	DESCRIPTION
piGain = 9.20	PI Controller gain outside of deadband. This value is the higher of two gain values used in the position PI loop. This value is used when the valve is moving. When the valve is in a stable position, a lower value is used to avoid noise-induced control action.
piResetT = 1000	PI Controller reset time outside of deadband. Used in PI equation along with the gain value described previously. This value is one of two used in the PI equation. This one is used when the valve is in motion, and causes faster wind-up. It is given in milliseconds.
piGainDb = 1.40	PI Controller gain inside of deadband. When the valve is in a steady position, the PI gain is reduced to this value. This helps avoid noise-induced control action.
piResetTDb = 10000	PI Controller reset time inside of deadband. This is one of two values used, and causes slower control action. It is given in milliseconds.
retreatRate	% per second rate of output retreat.
DIRECT =1	PI mode. In direct mode (DIRECT=1), the output goes in a direction with respect to target position. In indirect mode (DIRECT=0), the output goes negative when the target position moves negative with respect to position feedback.

<table>
<tr><th>COMMAND</th><th>DESCRIPTION</th></tr>
<tr><td>posErrorRetreat= 2.0</td><td>The output will not retreat until ABS| posFB - TargetPos| <posErrorRetreat</td></tr>
<tr><td>exitSeatVal=5000</td><td>When the RSR is seating the valve, then decides to retreat, this is the output in mV to which the output goes.</td></tr>
<tr><td>exitBkSeatVal=-5000</td><td>When the RSR is backseating the valve, then decides to retreat, this is the output in mV to which the output goes.</td></tr>
<tr><td>CASCADE=0</td><td>If this flag is set to 1, the two PI’s are cascaded.</td></tr>
<tr><td>demodGain = 12345</td><td>The LVDT secondary feedback sum is multiplied by this value to achieve a voltage range representing 0 to 100% position that is close to the input range of the A/D converter. The value is printed as a raw decimal value. The hexadecimal equivalent is written to the feedback D/A converter to adjust feedback gain. This value can be entered by the customer, but it is also modified automatically during the full calibration sequence. Feedback gain can be calculated by the following formula:
gain = 4096 / D/A converter input word (decimal value)
Examples of some gain values are as follows:
<table>
<tr><th>DAC word</th><th>Decimal value</th><th>Gain</th></tr>
<tr><td>0</td><td>0</td><td>Infinity[1]</td></tr>
<tr><td>1</td><td>1</td><td>4096</td></tr>
<tr><td>.</td><td>.</td><td>.</td></tr>
<tr><td>.</td><td>.</td><td>.</td></tr>
<tr><td>8</td><td>8</td><td>512</td></tr>
<tr><td>.</td><td>.</td><td>.</td></tr>
<tr><td>.</td><td>.</td><td>.</td></tr>
<tr><td>100H</td><td>256</td><td>16</td></tr>
<tr><td>.</td><td>.</td><td>.</td></tr>
<tr><td>.</td><td>.</td><td>.</td></tr>
<tr><td>800H</td><td>2048</td><td>2</td></tr>
<tr><td>.</td><td>.</td><td>.</td></tr>
<tr><td>.</td><td>.</td><td>.</td></tr>
<tr><td>FFFH</td><td>4095</td><td>1.00024</td></tr>
</table>
[1] Feedback gain D/A converter output saturates.</td></tr>
<tr><td>errorDbF = 1.0</td><td>When the absolute value of the difference between target position and actual position is greater that this value, the valve is considered to be in motion. Gain and reset values are selected to cause rapid control action. When the difference is less than this value, control action is softened.</td></tr>
<tr><td>errorDbS = 0.2</td><td>When the absolute value of the difference between target position and actual position is less than this value, the valve is considered to be stable. Gain and reset values are selected to soften control action. When the difference is greater than this value, gain is increased to yield sharper control action.</td></tr>
</table>

COMMAND	DESCRIPTION
seatLimit = 0.0	When target valve position is equal to or less than this value, seating action controls the output.
backSeatLimit = 100.0	When the target valve position is equal to or greater than this value, backseating action controls the output.
contingency = 10.0	If the absolute value of the difference between Servo Driver target position and actual position is greater than this value, a contingency condition may exist. The condition must exist until a timer expires for it to be reported. The timer is described below: A situation could arise where the Servo Driver target position and the Controller's target are not equal. One example would be if the shutdown input were true, the Servo Driver set the target position to 0, but the Controller did not track. In this situation, contingency would not be reported if the valve went to 0% position.
contingencyTime = 10000	If the error between target position and actual position exceeds contingency for this amount of time, then the condition is reported to the Controller. This number is given in milliseconds.
calhndrd = 30000	This value is displayed in decimal. It is the converted hexadecimal A/D converter reading for the 100% position. It can be entered by the customer; however, it is normally determined automatically by the calibration sequence.
calzero = -30000	This value is displayed in decimal. It is the converted hexadecimal A/D converter reading for the 0% position. It can be entered by the customer; however, it is normally determined automatically by the calibration sequence.

Configuration Commands

COMMAND	DESCRIPTION
FIP = 1<return>	Fail-in-place flag. If the fail-in-place flag is set, the valve will hold its last position when switching from **normal** mode to **local** mode. If the fail-in-place flag is clear (FIP = 0), the valve's target position will be forced to -5% when switching from normal to local mode.
RDNDNT = 1<return>	Redundant LVDT option. If the redundant LVDT option is selected, the Servo Driver will execute only 1 PI control loop. However, it will continue to process both position feedback channels, middle-selects each to reject some noise, then high-selects between the two feedback values. If the option is not selected (RDNDNT = 0), the Servo Driver behaves as a two-independent-channel closed loop servo control. **Note** This command has a different meaning for the Valve Positioner module.
PROP = 1<return>	Proportional output option. If the proportional output option is selected, the PI routine is not called. Instead, the position target in percent is copied directly to the output, in which case 0 to 100% demand would yield 0 to 10 volts at the output. Normally the proportional output is not selected (PROP = 0), resulting in a closed loop PI control subsystem.

Miscellaneous Commands

COMMAND	DESCRIPTION
V1<return>	Selects valve 1. The valve selected is indicated by the prompt character sequence. Subsequent commands affect only the selected channel.
V2<return>	Selects valve 2. The valve selected is indicated by the prompt character sequence. Subsequent commands affect only the selected channel.
EXIT<return>	Permits test and calibrate modes to be exited by executing a soft reset.
DG<return>	Display group data - This function repeatedly displays important operating parameters such as demand, feedback, and feedback voltage.
HELP<return>	Print command list

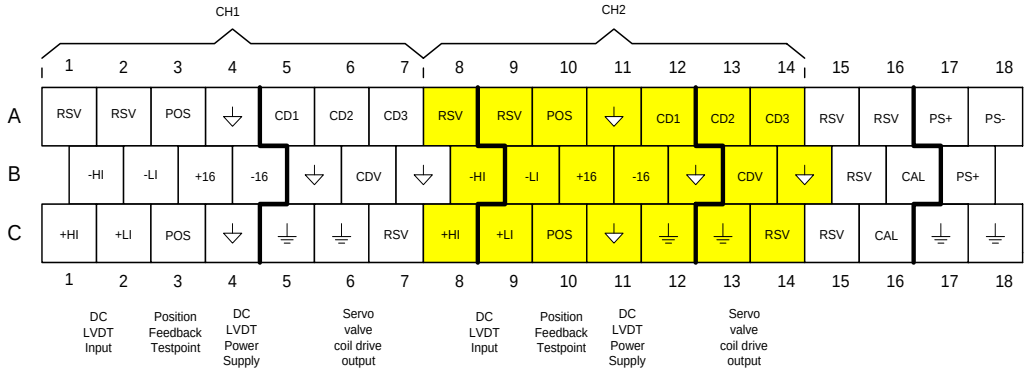
COMMAND	DESCRIPTION
diag<return>	This command displays important status information in hexadecimal format. Included is the operating mode for each channel, SFE register, signal register, and restriction register as follows: mod1=0xmm mod2=0xnn restricts=0xrrrrrrrr sgnls=0xssss sfe's=0xeeee where mm = Hex value for channel 1 mode: 0 through 5 are **start** modes 0x14 through 0x19 are **local** modes 0x28 through 0x2B are **normal** modes 0x3C through 0x3F are **test** modes nn = Mode for channel 2 rrrrrrrr = Restriction bit set as follows: bit 0 - PROM checksum error bit 1 - Memory diagnostic error bit 2 - Channel 1 contingency bit 3 - Channel 2 contingency bit 4 - Ovation serial bus not configured bit 5 - Mismatch of tuning constants between module and Controller bit 6 - Controller is not updating module bit 7 - Channel 1 - Controller is not tracking bit 8 - Channel 2 - Controller is not tracking bit 9 - EEPROM checksum error bit 10 - Hold until oscillator is stable bit 11 - Channel 1 - valve is under serial port control or calibrating bit 12 - Channel 2 - valve is under serial port control or calibrating ssss = Signal bits as follows: bit 10 - Channel 1 contingency bit 11 - Channel 2 contingency bit 12 - Display group is on bit 13 - Display group is turned on, display needs initialized eeee = Severe fatal error bits as follows: bit 0 - EEPROM checksum bit 1 - PROM checksum bit 2 - Shared memory readback error bit 3 - Processor memory readback error bit 4 - FPGA error on startup bit 5 - UART readback error bit 6 - Processor diagnostic error bit 7 - Not used bit 8 - PSD302 memory readback error

25.5 WIRING INFORMATION

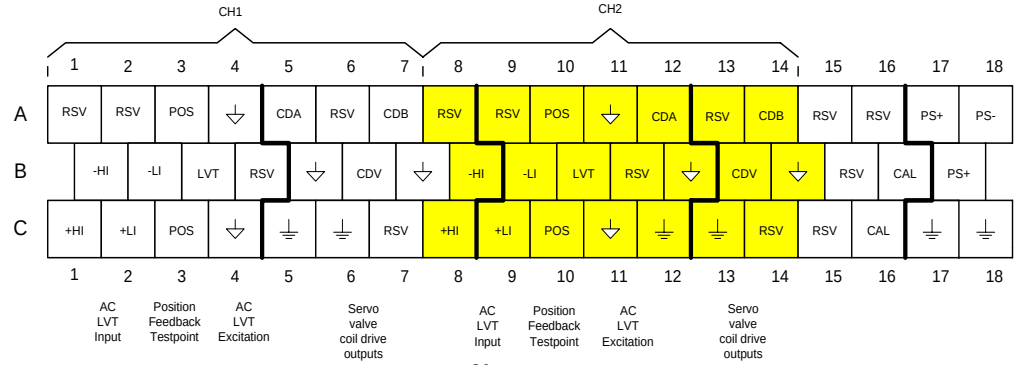
25.5.1 SERVO DRIVER TERMINAL BLOCK WIRING INFORMATION

Each Personality module has a simplified wiring diagram label on its side, which appears above the terminal block. This diagram indicates how the wiring from the field is to be connected to the terminal block in the base unit.

DC LVDT I/O Modules (for use with Group 1 Electronic and Personality Modules)


CH1
CH2
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18
A RSV RSV POS CD1 CD2 CD3 RSV RSV POS CD1 CD2 CD3 RSV RSV PS+ PS-
B -HI -LI +16 -16 CDV -HI -LI +16 -16 CDV RSV CAL PS+
C +HI +LI POS RSV +HI +LI POS RSV CAL
DC LVDT Input
Position Feedback Testpoint
DC LVDT Power Supply
Servo valve coil drive output
DC LVDT Input
Position Feedback Testpoint
DC LVDT Power Supply
Servo valve coil drive output

AC LVT I/O Modules (for use with Group 2 and 3 Electronic Modules and Group 2 Personality Modules)


CH1
CH2
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18
A RSV RSV POS CDA RSV CDB RSV RSV POS CDA RSV CDB RSV RSV PS+ PS-
B -HI -LI LVT RSV CDV -HI -LI LVT RSV CDV RSV CAL PS+
C +HI +LI POS RSV +HI +LI POS RSV CAL
AC LVT Input
Position Feedback Testpoint
AC LVT Excitation
Servo valve coil drive outputs
AC LVT Input
Position Feedback Testpoint
AC LVT Excitation
Servo valve coil drive outputs

Notes

1. Do not make connections to RSV termination blocks.
2. Do not make connections to CDV termination blocks (they are outputs of the FSR field board's Coil Drive buffers).
3. All of the field interface signals must use twisted-pair copper wire conductors inside a shielded cable assembly. The cable assembly shield must be tied to earth ground via one or more of the following termination block earth ground terminals: C5, C6, C12, or C13.

Figure 153: Terminal Block Connections for the Servo Driver Personality Modules

Abbreviations Used in Diagrams

ABBREVIATION	DEFINITION
	Earth ground terminals.
	Isolated circuit common ground.
+16, -16	DC LVDT Power Supply voltages, +16 VDC and -16 VDC.
CAL	A jumper may be installed across the two CAL inputs in order to force the module to enter factory test mode.
CDA	Primary 1000 ohm servo-valve coil drive output (AC LVT modules).
CDB	Secondary 1000 ohm servo-valve coil drive output (AC LVT modules).
CDV	Output of FSR field brand coil drive buffer (no connections allowed).
CD1 - CD3	CD1 = 60 ohm, 60 mA servo-valve coil drive output (DC LVDT modules). CD2 = 80 ohm, 40 mA servo-valve coil drive output (DC LVDT modules). CD3 = 40 ohm, 40 mA servo-valve coil drive output (DC LVDT modules).
+HI, -HI	Position feedback inputs - high range (DC LVDTs only).
+LI, -LI	Position feedback inputs - low range (DC LVDTs or AC LVTs).
LVT	AC LVT primary winding sinusoidal excitation output.
POS	Demodulated and amplified position feedback DC voltage (0.0 to 7.5 VDC)
PS+, PS-	Auxiliary power supply terminals (not used).
RSV	Reserved terminals. No connections allowed on these terminals.

25.5.2 SERVO DRIVER FIELD CONNECTION WIRING DIAGRAMS

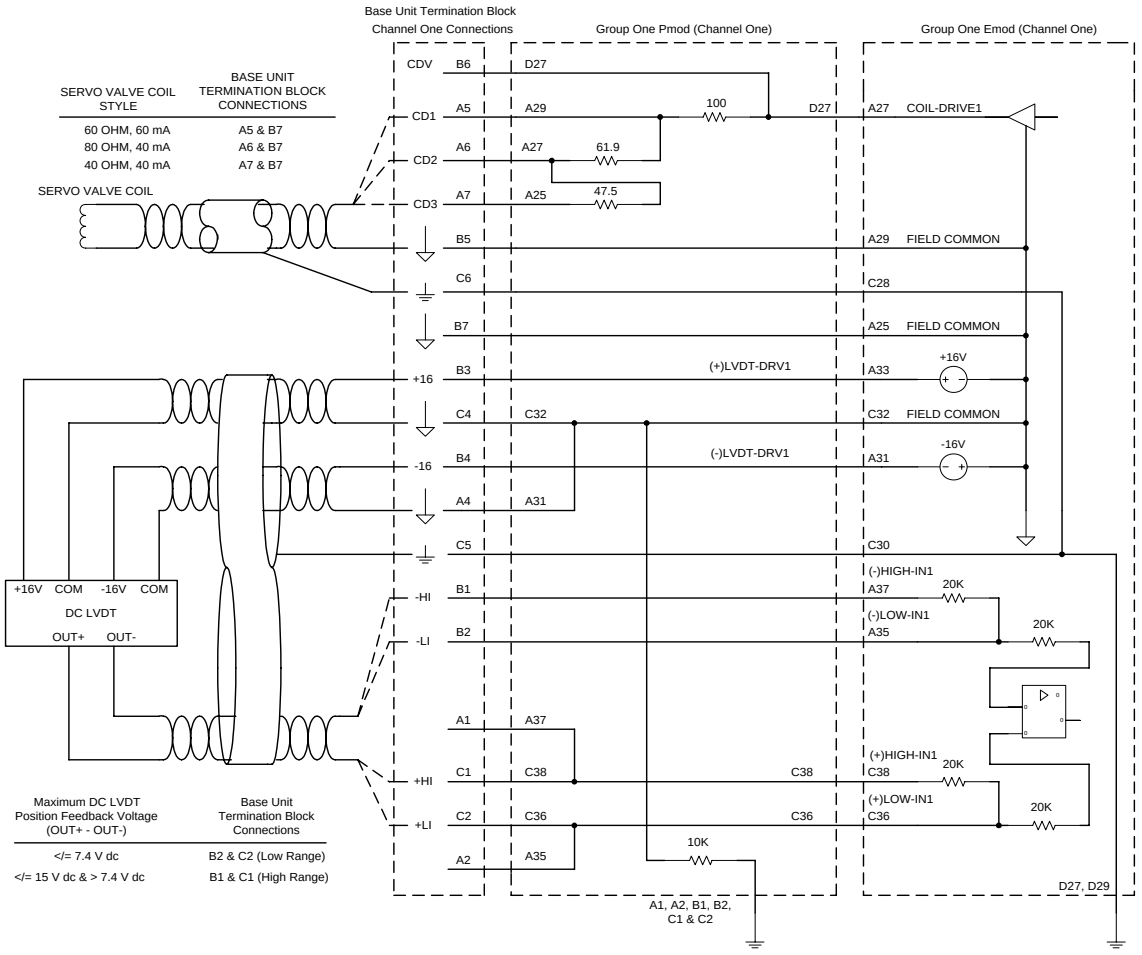


Figure 154: DC LVDT I/O Module Channel One Field Connection Diagram

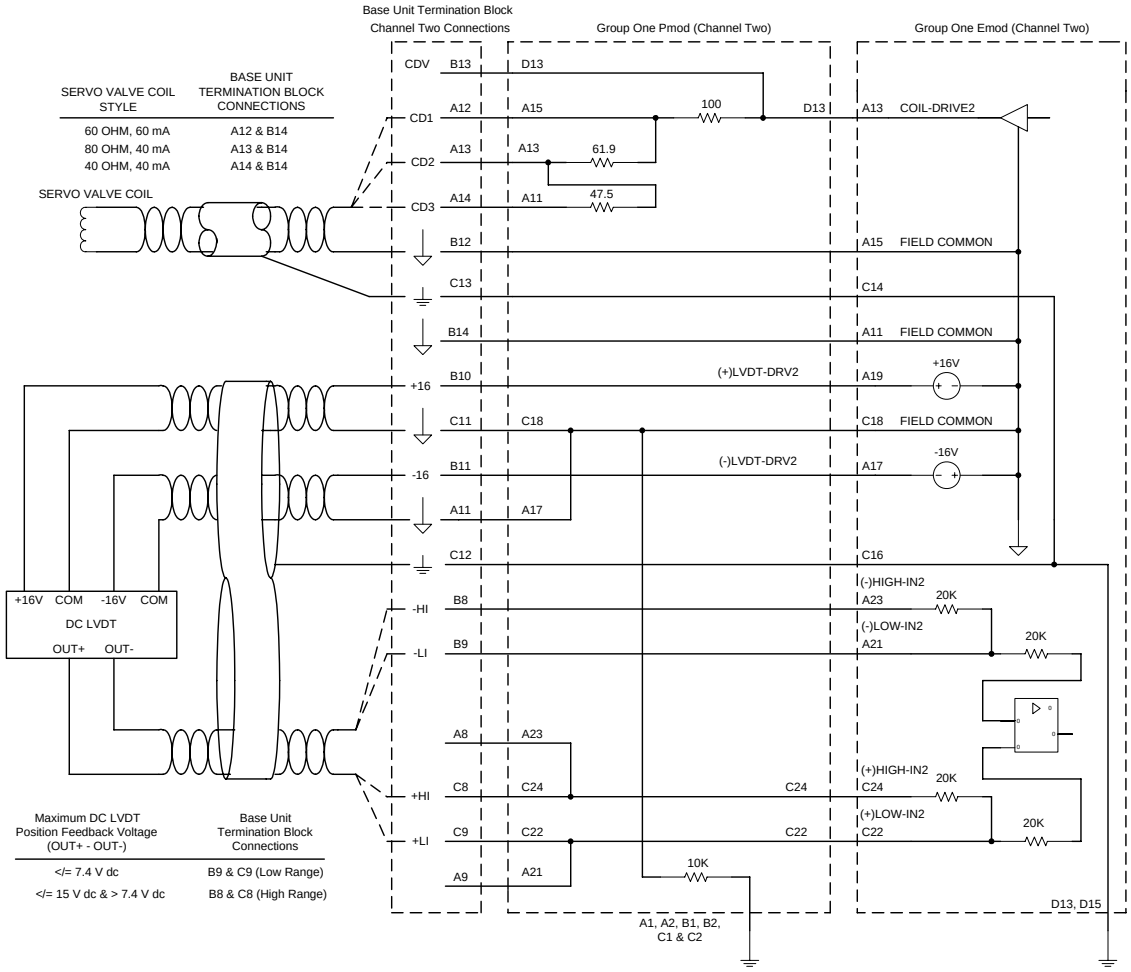


Figure 155: DC LVDT I/O Module Channel Two Field Connection Diagram

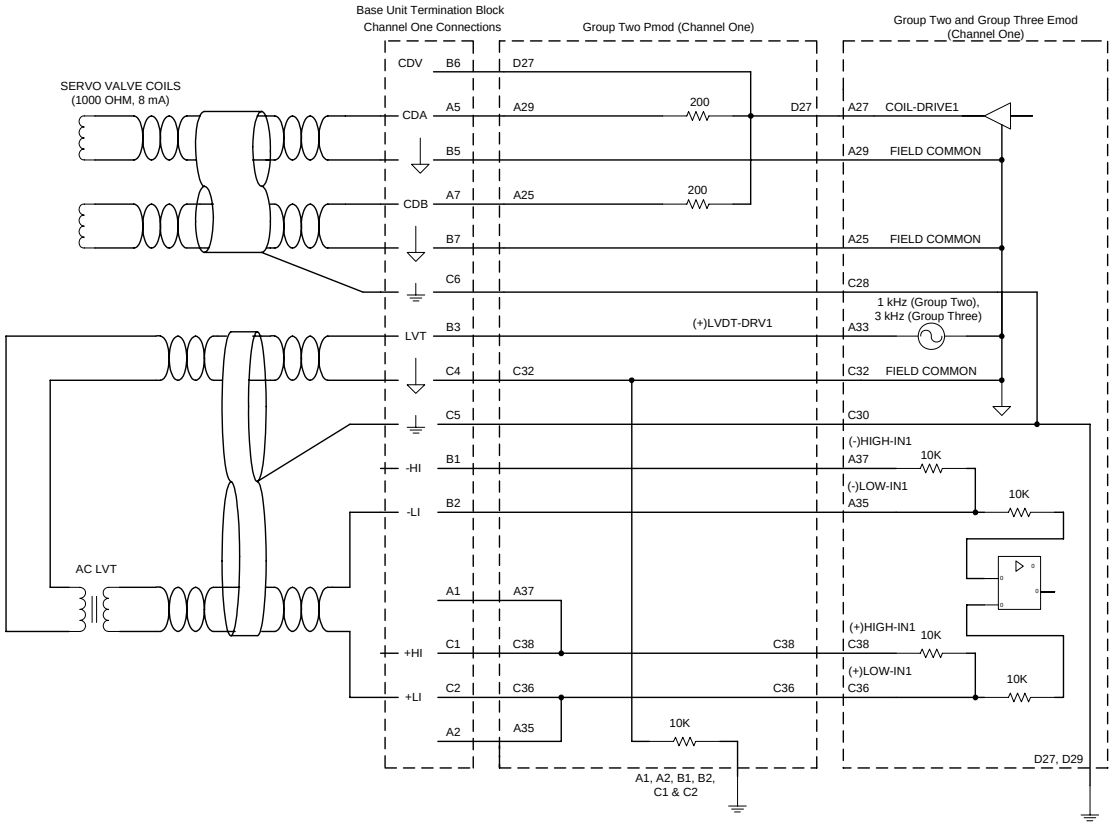


Figure 156: AC LVT I/O Module Channel One Field Connection Diagram

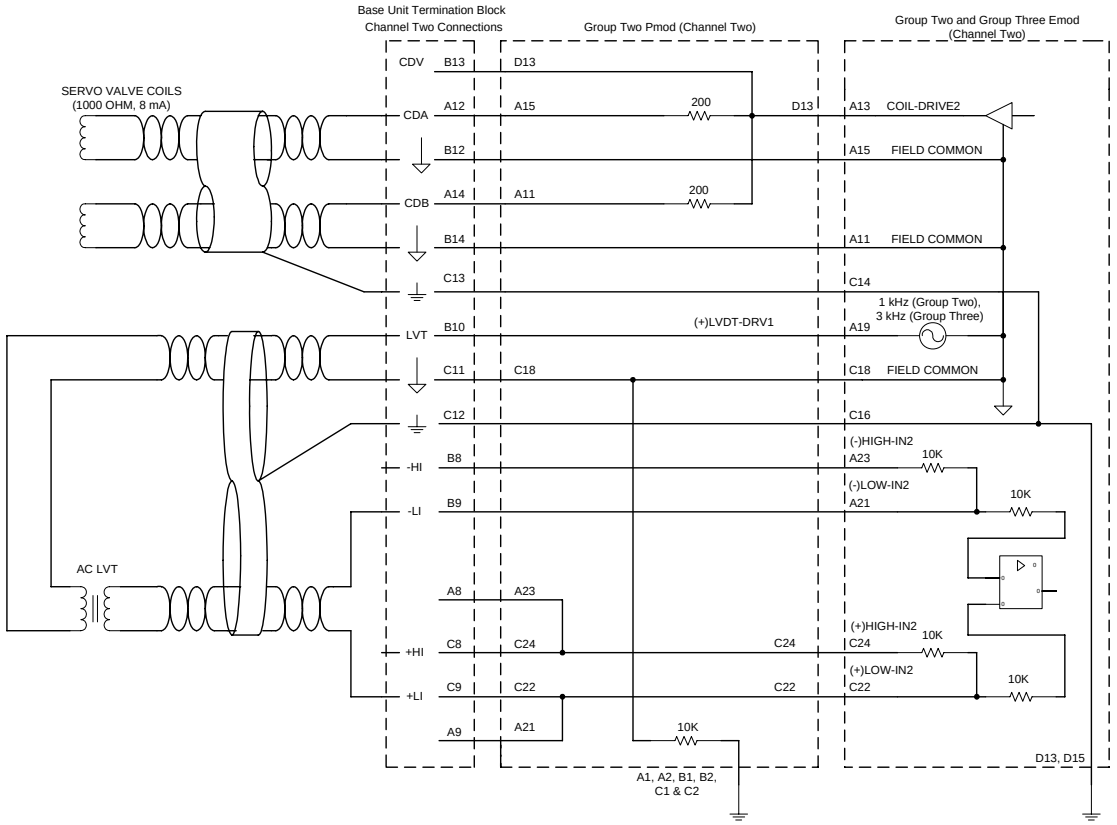


Figure 157: AC LVT I/O Module Channel Two Field Connection Diagram

25.6 ADDRESS LOCATION INFORMATION

25.6.1 CONFIGURATION AND STATUS REGISTER

Word address 13 (D in Hex) is used to configure the module and provide status information to the Controller. The status register can be read by using the Point Information window at an Operator Station (see the Bit Pattern Field on the Hardware Tab). Refer to the applicable "*Operator Station User Guide"* for information about the Point Information window.

Servo Driver Configuration/Status Register (Address 13 or D in Hex)

BIT	DATA DESCRIPTION - CONFIGURATION REGISTER (WRITE)	DATA DESCRIPTION - STATUS REGISTER (READ)
0	Configure Module (1 = configure)	Module is configured (1 = configured; 0 = unconfigured)
1	Force Error (1 = error; 0 = no error)	Internal or Forced Error (1 = error; 0 = no error)
2 - 4	Communications Timeout Setting [1] BIT 4 / BIT 3 / BIT 2 / TIMEOUT 0 0 0 16 seconds 0 0 1 4 seconds 0 1 0 2 seconds 0 1 1 1 seconds 1 0 0 500 milliseconds 1 0 1 250 milliseconds 1 1 0 125 milliseconds 1 1 1 62.5 milliseconds	Communications Timeout Setting [1] BIT 4 / BIT 3 / BIT 2 / TIMEOUT 0 0 0 16 seconds 0 0 1 4 seconds 0 1 0 2 seconds 0 1 1 1 seconds 1 0 0 500 milliseconds 1 0 1 250 milliseconds 1 1 0 125 milliseconds 1 1 1 62.5 milliseconds
5	Not used	Not used
6	Not used	Not used
7	Severe fatal error (SFE) bit Look at register E for more specific error information (error bits 0 through 6 in register E are OR'd to calculate this bit)	Severe fatal error (SFE) bit Look at register E for more specific error information (error bits 0 through 6 in register E are OR'd to calculate this bit)
8	Not used	Not used
9	Not used	Ch1 - Retreat in progress
10	Not used	Ch2 - Retreat in progress
11	Not used	Ch1 - Retreat is disabled
12	Not used	Ch2 - Retreat is disabled
13	Channel 1 contingency	Channel 1 contingency
14	Channel 2 contingency	Channel 2 contingency
15	EEPROM constants download request	EEPROM constants download request

[1] The tolerance on the timeout period is +/- 35%.

25.6.2 SEVERE ERRORS STATUS REGISTER

Word address 14 (E in Hex) provides for additional module configuration and module status. The bit definitions for this register are encoded.

Severe Error Status Register (Address 14 or E in Hex)

BIT	DATA DESCRIPTION - CONFIGURATION REGISTER (WRITE)	DATA DESCRIPTION - STATUS REGISTER (READ)
0	Not applicable	EEPROM checksum error
1	Not applicable	PROM checksum error
2	Not applicable	Shared memory readback error
3	Not applicable	Processor memory readback error
4	Not applicable	FPGA error
5	Not applicable	UART error
6	Not applicable	Processor diagnostic error
7	Not used	Not used
8	Not applicable	PSD 302 memory readback error
9	Not used	Not used
10	Not used	Not used
11	File transfer bit - Reserved	File transfer bit - Reserved
12	Controller-to-Servo Driver buffer control bit. If Bit 12 and Bit 14 of register D are equal, then the buffer is not busy, and the Controller can write into the buffer. If the two bits differ, then the Servo Driver should be in the process of unloading the buffer and will toggle Bit 14 when all data is removed. The Controller should not write into the buffer if the two bits are unequal. When the Controller has data to be transferred to the Servo Driver, and the two bits are equal, it will first write the data, then toggle this bit. (The buffer occupies indirect registers 80 to BF inclusive. This buffer is accessed by the Controller using addresses 0 through 3F.)	Not applicable

BIT	DATA DESCRIPTION - CONFIGURATION REGISTER (WRITE)	DATA DESCRIPTION - STATUS REGISTER (READ)
13	Servo Driver-to-Controller buffer status bit. If Bit 13 and Bit 15 of register D are equal, then the buffer is not busy (empty). When this bit and Bit 15 become unequal, there is data in the buffer. The bits being unequal signals the Controller to remove all data from the buffer. When all the data is removed, this bit should be toggled by the Controller. (The buffer occupies indirect registers C0 to FF inclusive. This buffer is accessed by the Controller using addresses 40 through 7F.)	Not applicable
14	Not applicable	Controller-to- Servo Driver buffer status bit. If Bit 14 and Bit 12 are equal, then the buffer is not busy (empty). When this bit and Bit 12 become unequal, there is data in the buffer. The bits being unequal signals the Servo Driver to remove all data from the buffer. When all the data is removed, this bit should be toggled by the Servo Driver. (The buffer occupies indirect registers 80 to BF inclusive. This buffer is accessed by the Controller using addresses 0 through 3F.)
15	Not applicable	Servo Driver -to-Controller buffer control bit If Bit F15 and Bit 13 are equal, then the buffer is not busy, and the Servo Driver can write into the buffer. If the two bits differ, then the Controller should be in the process of unloading the buffer and will toggle bit 13 when all data is removed. The Servo Driver should not write into the buffer if the two bits are unequal. When the Servo Driver has data to be transferred to the Controller, and the two bits are equal, it will first write the data, then toggle this bit. (The buffer occupies indirect registers C0 to FF inclusive. This buffer is accessed by the Controller using addresses 40 through 7F.)

25.7 DIAGNOSTICS

The Servo Driver runs diagnostics to ensure that the circuit is operating properly. When a problem is detected, a number of things may occur. If the error is considered to be a severe fatal error, the card will “dive.” This means that the output circuit will de-power, and the on-board processor will “idle.” For some fatal errors, the processor will be reset. Word register E in the serial bus shared memory contains important severe fatal error bits.

Other problems may cause a restriction bit to be set. Restriction bits prevent the module from changing modes. During startup, each mode uses a bit mask to determine if errors exist that would prevent the mode change. As the mode advances from start, to local, then to normal, the restriction mask has fewer and fewer bits set.

During restart, there is a 20 second time delay to allow the oscillator to stabilize. Diagnostics are run during this delay. The EPROM checksum is fully calculated.

25.7.1 EPROM CHECKSUM ERROR

The EPROM checksum is calculated completely on restart. After restart, the checksum program is called during idle time. Each call to the checksum adds one word to the sum.

Memory Read/Write Check

A failure of any memory to read back correctly is considered a severe fatal error. The memory check routine accesses memory in the PSD302 chip, on-chip memory, and serial bus shared memory.

EEPROM Checksum

On restart, tuning constants are read out of a 64x16 EE memory. If the checksum calculation indicates an error, an SFE bit is set and all modes are restricted. This error occurs in the factory during manufacturing, but should never occur in the field.

UART Check

A byte is written to the UART scratchpad register and read back. If the data does not read back correctly, an SFE bit is set and all modes are restricted.

FPGA Error

During restart, the FPGA is loaded by the 80196 Controller. Control and status lines connected to the FPGA must conform to the defined sequence, otherwise an SFE bit is set and all modes are restricted.

Controller Watchdog Timer

Microcontroller Firmware maintains a timer that is reset every time the Controller updates the Servo Driver with a new demand position. If the timer expires and the Servo Driver is in the normal operating mode, the module will revert back to the local operating mode.

The duration of the timer is set by three bits located in register D.

The microcontroller assumes an update has occurred when two conditions exist. First, it tests the CYCLEOK bit, which is an indication that a serial bus cycle to the module has occurred.

In addition to changing modes when the timer expires, a restriction bit is set to prevent return to normal mode. Updating demand will clear the restriction bit.

When the module switches to local mode, demand value is set to -5% if the “failInPlaceFlag” is cleared. If the “failInPlaceFlag” bit is set, demand value remains where it was when the mode change occurred.

25.8 DIAGNOSTIC LEDS

The following table lists the module’s LEDs and describes what they mean when lit.

Servo Driver Diagnostic LEDs

LED	DESCRIPTION
P (Green)	Power OK LED. Lit when the +5V power is OK.
C (Green)	Communications OK LED. Lit when the Controller is communicating with the module. Successful completion of sequence resets the watchdog timer.
E (Red)	External Fault LED.
I (Red)	Internal Fault LED. Possible causes: Force Error bit (Bit 1) of the Configuration Register is set. Also lit when a timeout of the watchdog timer occurs when Controller stops communicating with module.
1 - MODE (Green) Channel 1	Lit whenever the module is operating in Normal mode. Not lit whenever the module is operating in local manual mode.
1 - CONTINGCY (Red) Channel 1	Lit to indicate Contingency Condition.
1 - BACKSEAT (Green) Channel 1	Lit whenever seating or backseating is in effect.
1 - PI DETUNE (Green) Channel 1	Lit whenever PI is detuned.
2 - MODE (Green) Channel 2	Lit whenever the module is operating in Normal mode. Not lit whenever the module is operating in local manual mode.

LED	DESCRIPTION
2 - CONTINGCY (Red) Channel 2	Lit to indicate Contingency Condition.
2 - BACKSEAT (Green) Channel 2	Lit whenever seating or backseating is in effect.
2 - PI DETUNE (Green) Channel 2	Lit whenever PI is detuned.

25.9 SPECIFICATIONS

Electronics Module (1C31199)

Personality Module (1C31201)

Servo Driver Module Specifications

DESCRIPTION	VALUE
Servo driver field interface channels	Two
DC LVDT position feedback input range (1C31199G01)	Low Range Input 0 to 7.4 V DC (maximum range) 0 to 1.5 V DC (minimum range) High Range Input 0 to 15 V DC (maximum range) 0 to 5.0 V DC (minimum range)
AC LVT position feedback input range (1C31199G02, 1C31199G03)	Low Range Input 0.2 to 20 V AC peak-to-peak (maximum range) 0.2 to 5.0 V AC peak-to-peak (minimum range)
DC LVDT position feedback input impedance (1C31199G01)	Low Range Input 40 kΩ differential input with floating source 20 kΩ one input line referenced to common High Range Input 80 kΩ differential input with floating source 40 kΩ one input line referenced to common
AC LVT position feedback input impedance (1C31199G02, 1C31199G03)	Low Range Input 20 kΩ differential input with floating source 10 kΩ one input line referenced to common

DESCRIPTION	VALUE
DC LVDT supply output voltages (1C31199G01)	+16 V dc ± 5%, 30 mA max. load current (-)16 V dc ± 5%, 30 mA max. load current Supply output voltage matching: ±1.5% over temperature range
AC LVT excitation output voltage (1C31199G02, 1C31199G03)	19 V AC peak-to-peak ± 11% @ 1.0 kHz ± 10% (1C31199G02) 19 V AC peak-to-peak ± 11% @ 3.0 kHz ± 10% (1C31199G03) 500 Ω minimum load impedance
Peak servo valve coil output voltage (1C31199G01 DC LVDT)	CD1 100Ω output, 60 Ω coil, ±3.85 V or CD2 162Ω output, 80 Ω coil, ±3.4 V or CD3 210Ω output, 40 Ω coil, ±1.65 V
Peak servo valve coil output voltages (1C31199G02, 1C31199G03 AC LVT)	CDA output, 1000Ω coil, ± 8.55 V and CDB output, 1000Ω coil, ± 8.55 V
Servo valve coil output voltage accuracy (1C31199G01-G03)	0.4% of full scale output
Servo driver field interface dielectric isolation	±1000 V dc (for both channels) Both channels' field interface circuits have 50 V and 150 V short term isolation from the logic common/Ovation I/O bus. Each channel's field interface circuit has 50 V and 150 V short term isolation from the other channel's field interface circuit.
Serial port	RS-232, non-isolated
Serial port baud rate	9600
Module power	6.7 W typ. (1C31199G01 DC LVDT) 9.8 W max. (1C31199G01 DC LVDT) 5.3 W typ. (1C31199G02-G03 AC LVT) 6.3 W max. (1C31199G02-G03 AC LVT)
Logic board processor	80C196KB (16-bit microcontroller)
Operating temperature range	0 to 60°C (32°F to 140°F)
Storage temperature range	-40°C to 85°C (-40°F to 185°F)
Humidity (non-condensing)	0 to 95%

SECTION 26

SLIM (SMALL LOOP INTERFACE MODULE)

IN THIS SECTION

Description *408*
Module Specific Information *409*
Wiring Information *413*
Specifications *414*

26.1 DESCRIPTION

The Small Loop Interface Module (SLIM) provides the displays, keyboards inputs, and accompanying logic needed for the operator to monitor and control the I/O functions of an Ovation Loop Interface module (see page 237) or an Ovation Valve Positioner module (see page 425).

Information is presented to the operator by various bargraphs, LEDs, numeric displays and alphanumeric displays on the front panel of the SLIM. The keyboard allows the operator to send control information to the Ovation Loop Interface module to control the process.

The SLIM Module is applicable for CE Mark Certified Systems.

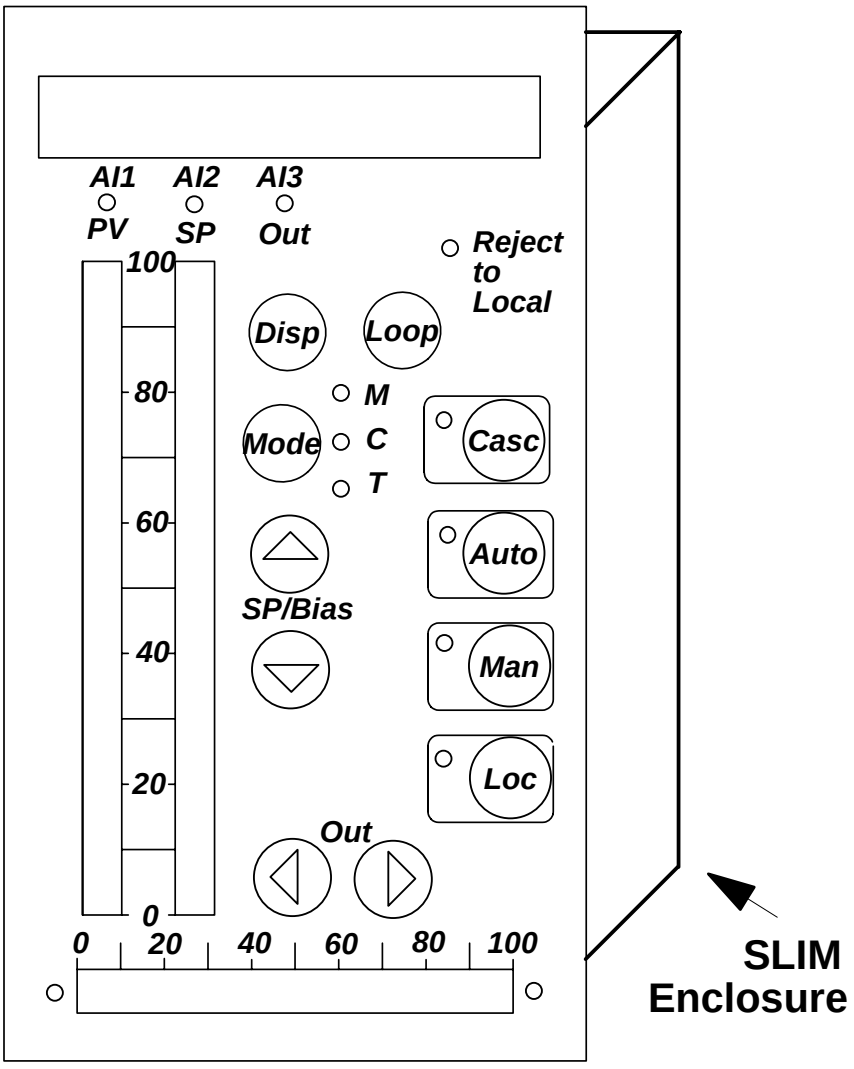


Figure 158: Small Loop Interface Module (SLIM) (4D33741)

26.2 MODULE SPECIFIC INFORMATION

26.2.1 FEATURES

Using keys on the front of the SLIM panel, the operator has the following capabilities:

- Raise output.
- Lower output.
- Raise set point.
- Lower set point.
- Change SLIM mode (Group 1 only).
- Group 1 SLIMs operate in four modes: CONTROL, MONITOR, TUNING, LOOP. Group 2 operates in CONTROL mode only.
- Change alphanumeric and numeric displays.
- Change Loop Interface mode to Auto, Manual, Local (all groups) or Cascade (Group 1 only).
- Change tuning constants (Group 1 only).
- Runs bargraphs, LEDs, and alphanumeric and numeric displays to monitor Loop Interface I/O activities.
- Scans keypad to control Loop Interface.
- Sends and receives information to and from the Loop Interface through a serial port.
- Flags a break in the communication link with the Ovation Loop Interface.
- Allows loop control even if the Ovation Controller is down.
- Displays:
  - Two 40-segment bargraph (for process variable and setpoint)
  - One 30-segment bargraph (for output)
  - One 4-digit numeric (for setpoint, output, process variable or analog input)
  - One 4-digit alphanumeric (for engineering units, status or SLIM mode information)
  - Thirteen status LEDs (for SLIM modes, Loop Interface modes as well as high and low limit conditions output)
- Control keys:
  - Four keys to raise and lower set point and outputs
  - Seven function keys

26.2.2 GROUPS AND MODES

The SLIM card is packaged in one of two possible assemblies. The keyboards are the same, except Group 2 does not have the LOOP, CASC, and MODE buttons.

Group 1	Allows the operator to choose from among four modes of operation for the SLIM and four for the Loop Interface.
Group 2	Offers no choice of modes for the SLIM; it always operates in the CONTROL mode. Offers three choices of operation of the Ovation Loop Interface.

The four modes of operation for the SLIM are as follows:

CONTROL MODE:	Allows the operator to send control information to the Ovation Loop Interface through a keyboard; displays the process variable, the setpoint, and output value for the Ovation Loop Interface on a bargraph, and displays PV, SP, or OUT with proper engineering units on an alphanumeric display.
MONITOR MODE: (Group 1 only)	Displays the process variable, the set point, and output values for the Ovation Loop Interface on a bargraph and displays the analog input values on an alphanumeric display. Note that the Loop Interface does not contain an AI3 input.
TUNING MODE: (Group 1 only)	Displays the gain, reset, rate, and derivative gain values for the Ovation Loop Interface it is communicating with and enables the operator to change the values. Requires a password.
LOOP MODE: (Group 1 only)	Displays the Loop Number of the Loop Interface to which the SLIM is currently communicating.

Note

Only one Ovation Loop Interface may be connected to a SLIM.

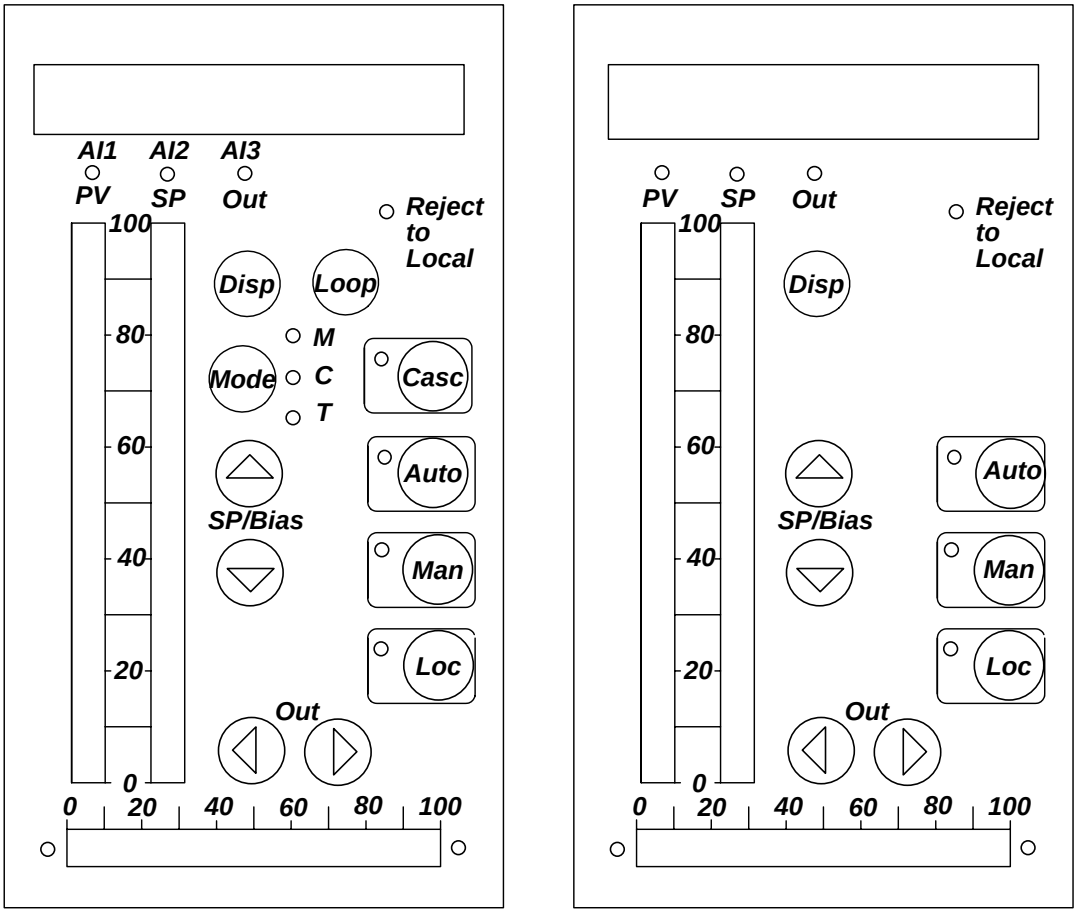


Figure 159: Keyboards for Group 1 and Group 2 SLIMs

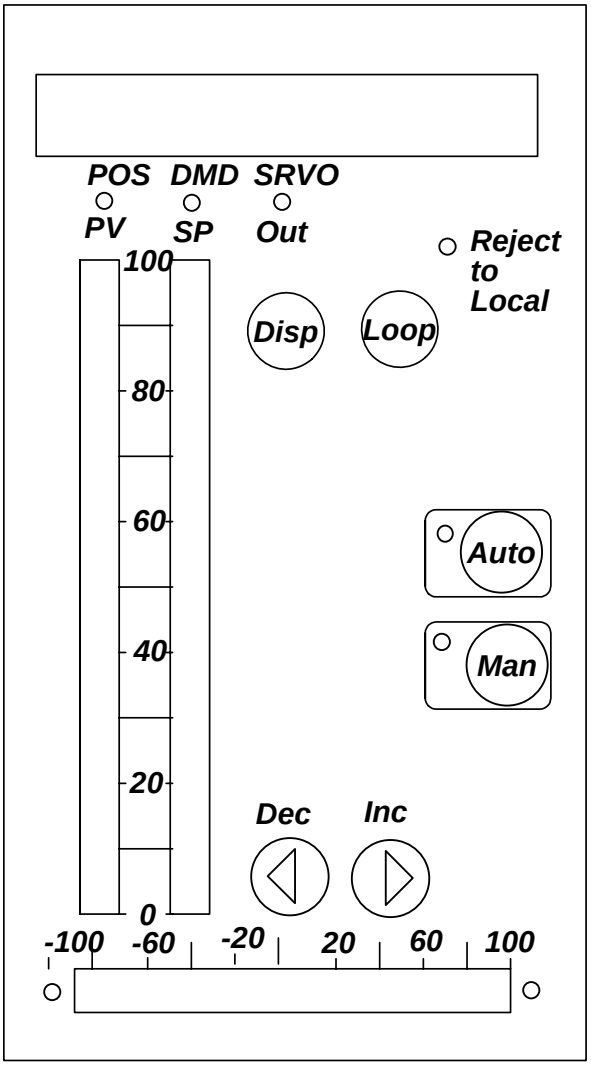


Figure 160: Keyboards for Group 3 and Group 4

26.3 WIRING INFORMATION

26.3.1 WIRING

Power cables to the SLIM must be single stranded #16 AWG copper conductors with ring lugs on both ends. Power required at the terminal block of the SLIM is 0.5A at +12 VDC. No shielding is required. A backup power supply is optional.

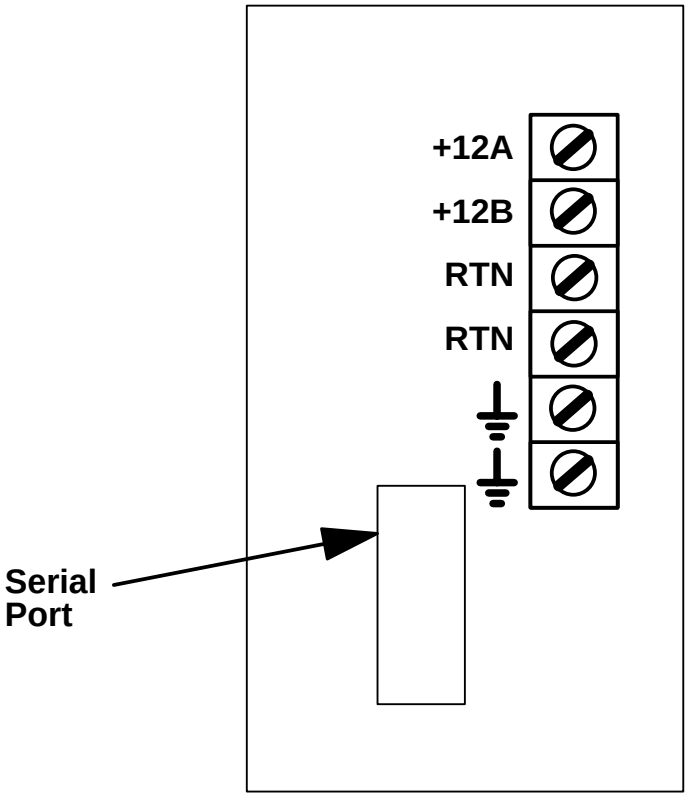


Figure 161: Wiring

In installations with more than one SLIM, each SLIM should have its own pair of conductors directly from the power supply. If SLIMs are connected in parallel, conductors must be able to accommodate the total current requirement for all SLIMs; voltage must measure +12 VDC at the last SLIM in the line.

Serial Port

The Serial Port receives display and status data from the Loop Interface and also sends operator inputs from the keyboard to the Loop Interface. The port can communicate with only one Loop Interface.

Serial Port Card-Edge Connector

COMPONENT SIDE PIN	DESCRIPTION
1	Transmit **+**
2	Transmit **-**
3	Shield (Signal Ground)
4	Receive **+**
5	Receive **-**
6 through 10	Not Used

Assemblies

- Cable assembly **5A26166** is used to connect the Ovation Loop Interface module to the SLIM in non-CE Mark certified systems.
- Cable assembly **5A26429** is used to connect the Ovation Loop Interface module to the SLIM in CE Mark certified systems.
- SLIM Power Supply Tray **4D33743Gxx** is used to power the SLIM in non-CE Mark certified systems.

26.4 SPECIFICATIONS

- Current input
  - 0.30 A typical @ 12 V +5%, -10%
    0.50 A maximum
- Isolation
  - 500 VDC output to chassis ground
- Humidity (non-condensing)
  - 0 to 95%

SECTION 27

SPEED DETECTOR MODULE

IN THIS SECTION

Description *415*
Module Group Information *415*
Wiring Information *417*
Address Location Information *420*
Diagnostic LEDs *421*
Specifications *422*

27.1 DESCRIPTION

The Speed Detector Module determines the speed of a piece of equipment by measuring the frequency of the output signal from a tachometer. The tachometer output can be sinusoidal or a pulse train. The Speed Detector provides a 16-bit output at an update rate of 5 milliseconds for over-speed detection, and a 32-bit output at a variable update rate for speed regulation.

27.2 MODULE GROUP INFORMATION

27.2.1 ELECTRONICS MODULE (EMOD)

There is one Electronics module group for the Speed Detector Module:

- **1C31189G01**

27.2.2 PERSONALITY MODULE (PMOD)

There is one Personality module group for the Speed Detector Module:

- **1C31192G01**

27.2.3 SUBSYSTEMS, SPEED DETECTOR

Speed Detector Subsystems [1]

RANGE	CHANNELS	ELECTRONIC MODULE	PERSONALITY MODULE
16 bit speed (Low Res) 200 Hz min - 51200 Hz max	8	1C31189G01	1C31192G01
32 bit speed (High Res) 0.72 Hz min - 65535 Hz max	8	1C31189G01	1C31192G01

When using the Point Builder to define points for a Speed Detector module, only the following point types are valid for each channel:

I/O Channel	Name	Type	Terminal Block Connection
1	High Resolution (speed value)	Input (can select I/O 1 or 3)	In
3	Low Resolution (speed value)	Input (can select I/O 1 or 3)	In
5	Open Wire	Input	Not applicable
11	Latched Overspeed	Input	Not applicable
12	Overspeed	Input	Not applicable
13	Trip Relay Status	Input	Not applicable
1	Trip Relay	Output	Relay
2	Reset Calculations	Output	Not applicable

[1] This module will interface to **ONE** speed sensor to determine the rotation speed of a field device.

27.3 WIRING INFORMATION

27.3.1 SPEED DETECTOR TERMINAL BLOCK WIRING INFORMATION

Each Personality module has a simplified wiring diagram label on its side, which appears above the terminal block. This diagram indicates how the wiring from the field is to be connected to the terminal block in the base unit.

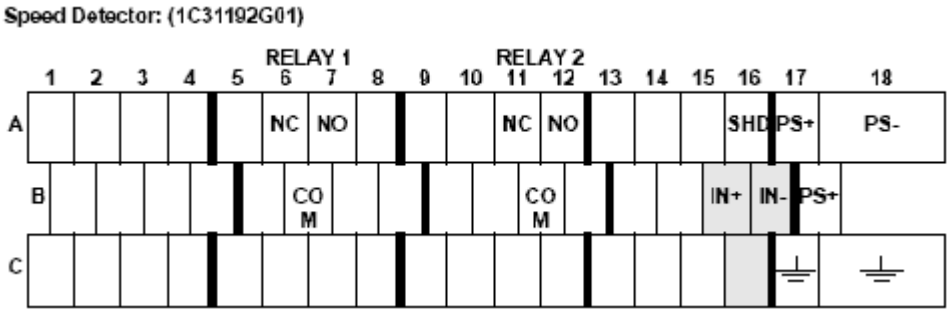
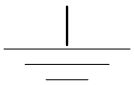


Figure 162: Terminal Block Connections for the Speed Detector Personality Module

The following table lists and defines the abbreviations used in this diagram.

Abbreviations Used in Diagrams

ABBREVIATION	DEFINITION
COM	Common terminal of relay's contact.
	Earth ground terminals used to connect to input signal's shield (see the figure below for field connections).
IN+, IN-	Positive and negative terminal connections of input signal.
NC	Normally closed terminal of relay's contact.
NO	Normally open terminal of relay's contact.
SHD	Shield (see page 418) of input signal's cable.

All field signals leaving/entering the cabinet should be in shielded cables. The frequency input signal from the signal source must be in twisted-pair shielded cables. The shield must be grounded (see page 418).

Note: *Do* ***not*** *use unmarked terminal block locations.*

27.3.2 SPEED DETECTOR FIELD CONNECTION WIRING DIAGRAMS

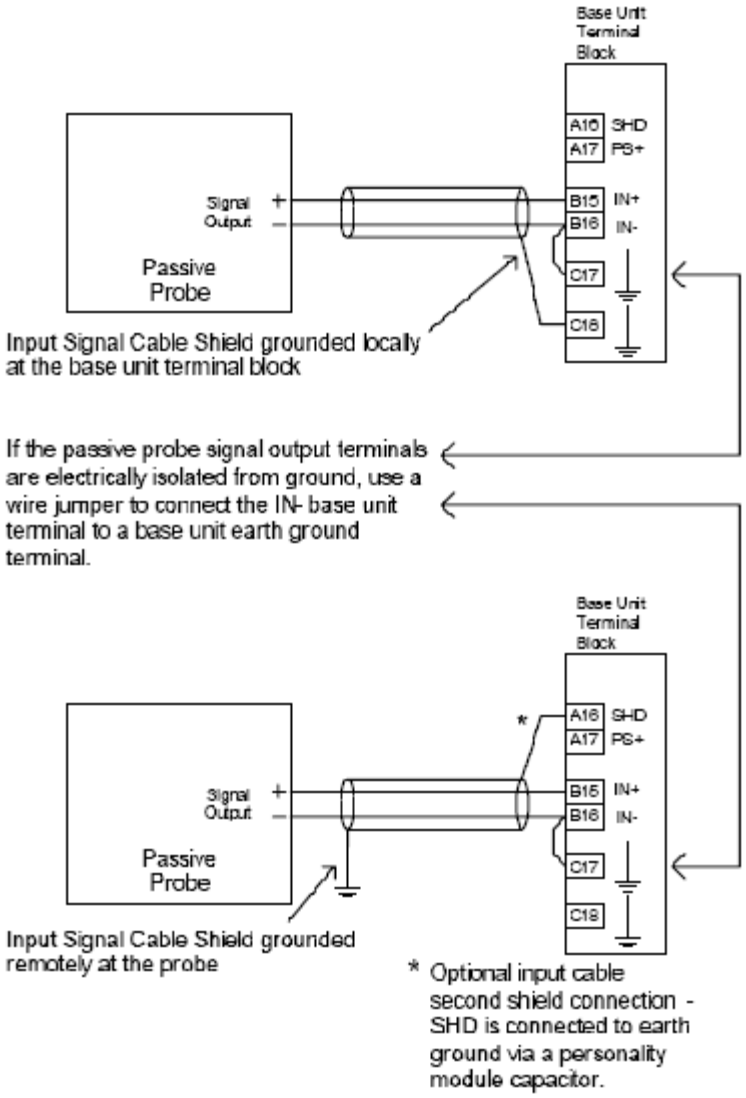

Base Unit Terminal Block
A16 SHD
A17 PS+
B15 IN+
B16 IN-
C17
C18
Signal Output
Passive Probe
Input Signal Cable Shield grounded locally at the base unit terminal block
If the passive probe signal output terminals are electrically isolated from ground, use a wire jumper to connect the IN- base unit terminal to a base unit earth ground terminal.
Base Unit Terminal Block
*
A16 SHD
A17 PS+
B15 IN+
B16 IN-
C17
C18
Signal Output
Passive Probe
Input Signal Cable Shield grounded remotely at the probe
* Optional input cable second shield connection - SHD is connected to earth ground via a personality module capacitor.

Figure 163: Passive Probe Field Connections for the Speed Detector PMod

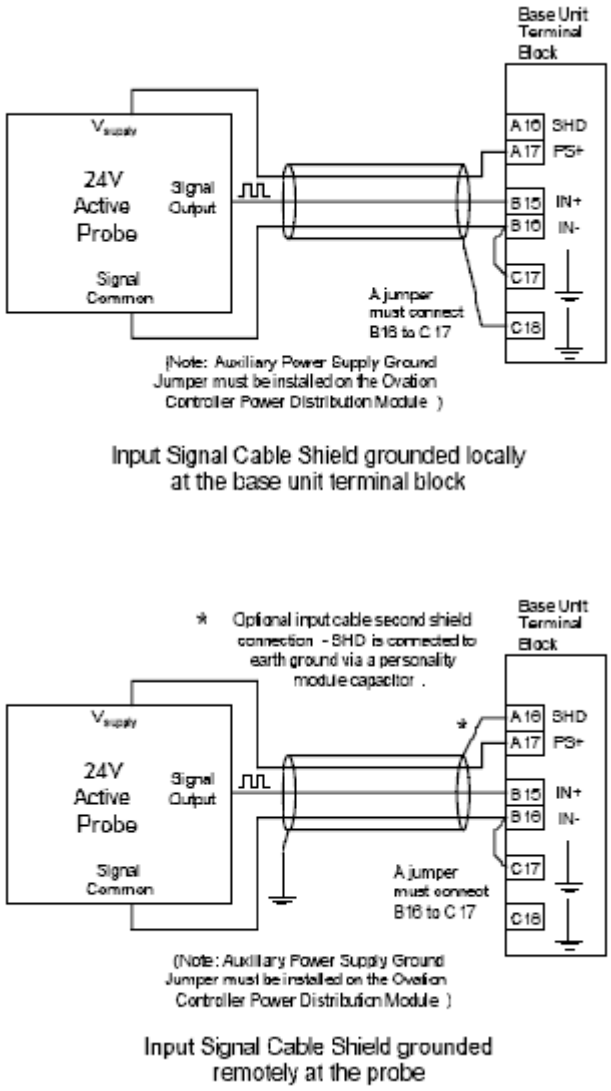


Figure 164: Active Probe Field Connections for the Speed Detector PMod

27.4 Address Location Information

27.4.1 Configuration and Status Register

Word address 13 (D in Hex) is used to configure the module and provide status information to the Controller. The status register can be read by using the Point Information window at an Operator Station (see the Bit Pattern field on the Hardware tab). Refer to the applicable "*Ovation Operator Station User Guide*" for information about the Point Information window.

Speed Detector Configuration/Status Register (Address 13 or D in Hex)

Bit	Data Description - Configuration Register (Write)	Data Description - Status Register (Read)
0	Configure Module (1 = configure; 0 = unconfigure, causing a stoppage of both output measurements)	Module Configured (1 = configured; 0 = unconfigured causing a stoppage of both output measurements)
1	Force Internal Error (1 = force an attention status to be read by Controller; 0 = no forced error)	Forced Internal error (1 = forced error set by Controller; 0 = no forced error)
2	Not used	Not used
3	Not used	Not used
4	Not used	Bit 4 = 1, Open wire condition detected.
5	1 = enable open wire test	Bit 5 = 1, Open wire test enabled.
6	Not used	Not used
7	Not used	Not used
8	Not used	Not used
9	Not used	Not used
10	Not used	Bit 10 = 1, currently in overspeed condition.
11	Not used	Bit 11 = 1, an overspeed condition detected since last read of register D. Reading register D will clear this bit.
12	Not used	Bit 12 = 0, relay open. Bit 12 = 1, relay energized.
13	Not used	Not used.
14	Relay control 1	Relay control 0
15	Relay control 2	Relay control 1

Secondary Configuration and Status Register

Word address 14 (E in Hex) provides the Pulse Count per update setting.

Overspeed Register

Word address 12 (C in Hex) provides the Overspeed Condition setting.

How to Specify the Pulse Count Per Update Setting

Determine the update period of the 32-Bit speed output. Normally, this is used to control the speed of equipment where accuracy is important. A longer update period will permit an higher accuracy output. Therefore, the maximum update period allowed by the control loop should be used to update the Speed Detector module's 32-Bit speed output.

Example: The Ovation control system runs at a 50 millisecond loop time. The equipment operates at 10,000 Hz. The largest Pulse Count per Update setting that should be written to register 0EH = 10,000 Hz x 0.050 seconds) = 500

Another factor that should be considered is the number of teeth in the speed sensor's gear. The Speed Detector module provides the speed sensor output signal frequency. The Ovation control system regulates equipment speed in revolutions per minute (rpm) using the measured Speed Detector module speed sensor output frequency (Hz) as follows:

Equipment speed (rpm) = 60 x frequency (Hz) / number of teeth in the gear.

To eliminate errors due to mechanical differences of teeth in the gear, complete revolutions of the speed sensor's gear must be counted when measuring frequency. To implement this requirement, the Pulse Count per Update setting written to Speed Detector module register 0EH should be specified as an integer multiple of the speed sensor gear teeth quantity.

Example: There are 60 teeth in the speed sensor's gear. With a 50 millisecond loop time and with the equipment operating at 10,000 Hz, the largest speed Speed Detector module Pulse Count per Update setting (written to register 0EH) is 500. The largest integer multiple of 60 teeth that is less than the maximum pulse count per update setting of 500 is 8. Therefore, a Pulse Count per Update value of 8 x 60 = 480 should be written to register 0EH as the Pulse Count per Update. The Pulse Count per Update is set to 480 in order to be a multiple of the number of teeth in the gear. The Pulse Count per Update setting of 480 provides an update every (480/10,000 = 48 milliseconds) which is fast enough for a 50 millisecond control loop.

For this example, a value of 01EOH (480) should be written to the Speed Detector.

27.5 DIAGNOSTIC LEDS

The following table lists the module's LEDs and describes what they mean when lit.

Speed Detector Diagnostic LEDs

LED	DESCRIPTION
P (Green)	Power OK LED. Lit when the +5V power is OK.
C (Green)	Communications OK LED. Lit when the Controller is communicating with the module at least once every two seconds.
E (Red)	External Error LED. Lit when the Open Wire (Bit 6 of module reply status register) is detected.
I (Red)	Internal Error LED. Lit when the Force Error bit (Bit 1 of register D) is detected. Also lit when a timeout of the watchdog timer occurs when Controller stops communicating with module for two seconds.
1 (Green)	Lit when overspeed is detected.
2 (Green)	Lit when relays are energized.

27.6 SPECIFICATIONS

Electronics Module (1C31189) [1]

Personality Module (1C31192)

Speed Detector Module Specifications

DESCRIPTION	VALUE
Number of Channels	1
Input Frequency Range	0.72 Hz to 65535 Hz for the 32-Bit Speed Output 200 Hz to 51,200 Hz for the 16-Bit Speed Output
Speed Measurement Resolution	1/65535 Hz for the 32-Bit Speed Output 1 Hz for the 16-Bit Speed Output
Guaranteed Speed Measurement Accuracy (@25×C)	Max. error for the 16-Bit Speed Output is 0.0033% of Sensor Frequency Speed Input Max. error for the 32-Bit Speed Output is the greater of 0.0025% or [(25/106) + (1/(24 x 106 x Update Period))] x 100% of Speed Sensor Frequency Input Update Period = PULSES/FREQ (in seconds) FREQ = Speed Sensor output frequency PULSES = User specified Speed Sensor Pulse Count per 32-Bit Speed Output value update

DESCRIPTION	VALUE
Speed Output Update Rate	Update Period = 5 milliseconds for the 16-Bit Speed Output Update Period = PULSES/FREQ (in seconds) for the 32-Bit Speed Output FREQ = Speed Sensor output frequency PULSES = User specified Speed Sensor Pulse Count per 32-Bit Speed Output value update
Differential Input Impedance:	50 K OHM
Diagnostics	Open Speed Sensor Wires Detection (Speed Sensor source resistance must be </= 5000 ohms). Over-speed detection.
Dielectric Isolation: Field Circuit to Logic Common	1000 VAC/DC
Max. Input Withstand Voltage	140 VAC rms or 150 VDC
Max. Usable Input Voltage	200 V peak-to-peak
Max. Off-State Input Voltage	0.2 V peak-to-peak
Input Duty Cycle	20% Min. - 80% Max.
Max. Input DC Offset	150 VDC -0.5 x Max. Input Voltage (peak-to-peak)
Normal Mode Rejection	Maximum 140 VAC or 150 VDC
Module Power	4.8 W typical, 6.25 W maximum
Operating Temperature Range	0×C to 60×C (32×F to 140×F)
Storage Temperature Range	-40×C to 85×C (-40×F to 185×F)
Humidity (Non-Condensing)	0 to 95%
[1] Refer to the table below for information about different revisions of 1C31189.	

Minimum Input Voltage (Peak-to Peak)

1C31189 REVISION 1	1C31189 REVISIONS 2 AND 3	1C31189 REVISION 4 OR LATER	INPUT SIGNAL FREQUENCY RANGE
5 volts	1 volt	1 volt	From 0.72 Hz up to 5 Hz
5 volts	1 volt	0.5 volt	From 5 Hz up to 1 kHz
5 volts	1 volt	1 volt	From 1 kHz up to 10 kHz
5 volts	1 volt	2 volts	From 10 kHz up to 20 kHz
10 volts	10 volts	10 volts	From 20 kHz up to 40 kHz
20 volts	20 volts	20 volts	From 40 kHz up to 50 kHz
40 volts	40 volts	40 volts	From 50 kHz up to 65535 Hz

SECTION 28

VALVE POSITIONER MODULE

IN THIS SECTION

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Wiring Information *460*
SLIM Serial Port Connector *469*
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Diagnostics *472*
Troubleshooting *474*
Diagnostic LEDs *477*
Specifications *478*

28.1 DESCRIPTIONS

28.1.1 DESCRIPTION FOR SINGLE VP MODULE

The Digital Electro-Hydraulic (DEH) system controls steam turbine valve positions in order to adjust steam flow for turbine speed control, or to change generator load when connected to the grid. The Ovation Valve Positioner I/O module provides an interface between the DEH Ovation Controller and an electro-hydraulic servo valve actuator. Valve styles controlled by the Ovation Valve Positioner I/O module include throttle valves, governor valves, interceptor valves, extraction valves, and bypass valves. The Ovation Valve Positioner module provides closed-loop valve positioning control.

A valve position set point is maintained by the module. The set point is normally altered by the Ovation Controller via the Ovation I/O bus. If the Ovation Valve Positioner module operates in Local Manual mode, the set point is controlled by a SLIM operator interface station. Inside the electronics module, an 80C196 microcontroller provides real-time closed loop proportional-plus-integral (PI) control.

The Ovation Valve Positioner I/O module generates redundant output control signals which drive the electro-hydraulic servo valve actuator coils. The feedback loop is closed with the valve's position measurement being obtained from a Linear Variable Differential Transformer (LVDT) that is mounted on the valve stem.

The Valve Positioner module can perform the following:

- Calibration
- Diagnostics
- 10 millisecond loop time
- SLIM interface for local control
- Local serial interface for testing and calibration
- Shutdown input
- Seating and backseating logic

The Valve Positioner Module is applicable for CE Mark Certified Systems.

Description and Guidelines for Redundant VP Module

Two Ovation Valve Positioner (VP) cards operate as a Primary/Backup pair to control a single steam valve. The steam valve is fitted with two LVDTs, one connected to each Valve Positioner. Each VP then drives one coil in a high pressure hydraulic servo valve. The coils are completely isolated.

The Valve Positioners communicate serially to determine which VP should be Primary, and which should be Backup. Critical parameters of the redundant subsystem are exchanged over the serial link. These critical parameters are also exchanged over the Ovation bus, thus providing a redundant data path.

The Backup VP suspends its software PI routine, and replicates the servo output of the Primary. It then takes over control if the Primary fails. There are three types of failures that the subsystem will detect and respond to:

- Hardware Failures - Each VP continuously runs internal diagnostics and will cease operations if a diagnostic fails. A failure is indicated when both the serial communications and Ovation line watchdog timers expire. The VP card continuously executes these diagnostics:
  - Microcontroller RAM
  - Ovation RAM
  - EPROM Checksum
  - DA Converter Readback
  - Ovation Watchdog Timer
  - Redundant Communications Watchdog Timer

- Coil Drive - If the Primary VP detects a shorted or open servo coil, it will transfer control to the Backup VP. There is a customer setup requirement described in the section on servo coil failures.
- LVDT Failures - LVDT failures are detected by measuring the derivative of position feedback. As with the servo coil, there are setup requirements that enable the detection of LVDT problems. The requirements are described in the section on LVDT failures.

The VP pair utilizes the SLIM serial port for VP-to VP communications. The serial link is a VP-to-VP connection, not the “party-line” bus utilized with the SLIM.

Failover events are NOT bumpless (that is, the valve will dip, or move in the direction indicated by the mechanical bias setting, during the failover period). Catastrophic hardware failures, or removal of the Primary VP, are the worst failures because the Backup must wait for various timers to expire and then engage the PI loop.

If, for example, the failover required one second to complete (determined by the Controller loop time for example), and the valve was programmed to drift shut in 30 seconds under control of the mechanical bias-setting, the valve could drift 3% (=1/30).

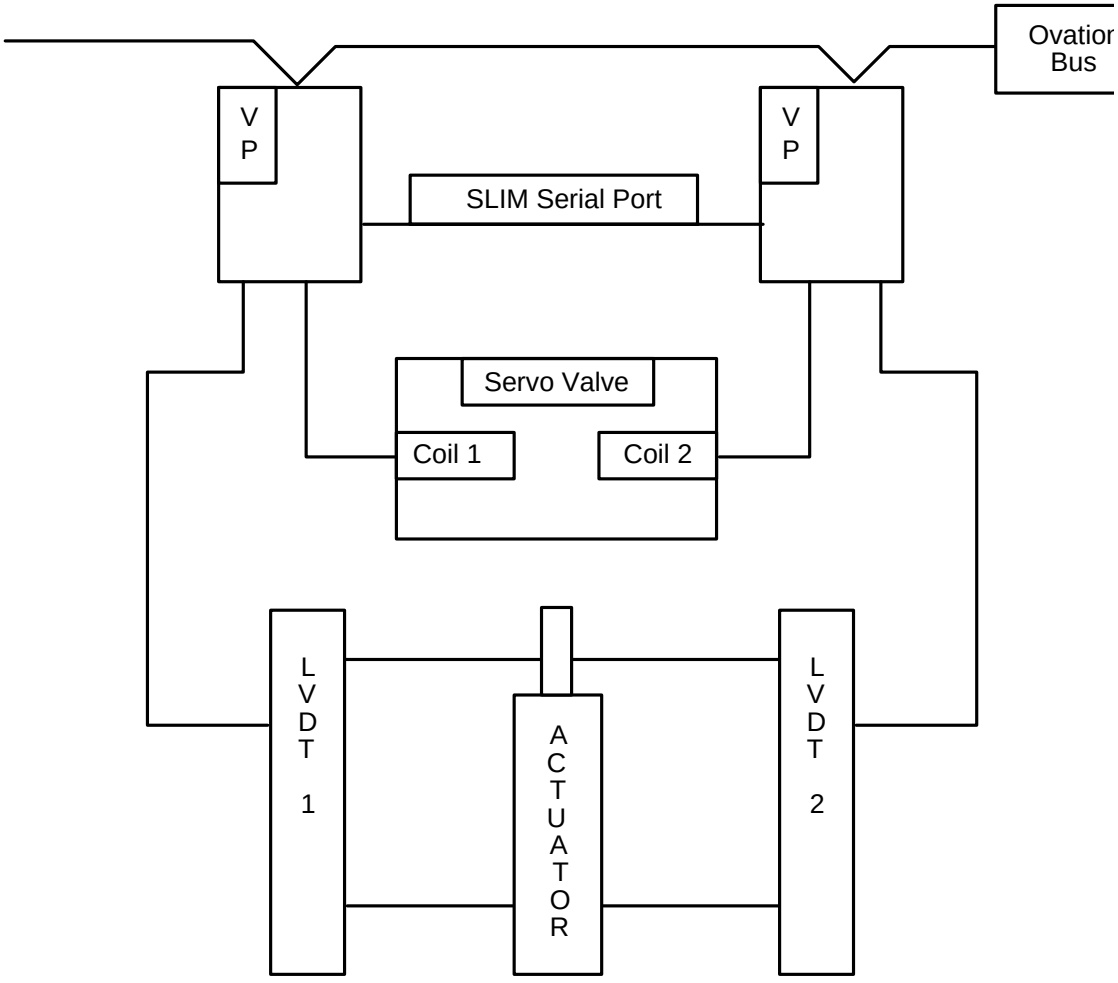


Figure 165: Redundant Ovation Valve Positioner Subsystem

VP-to VP Serial Connection

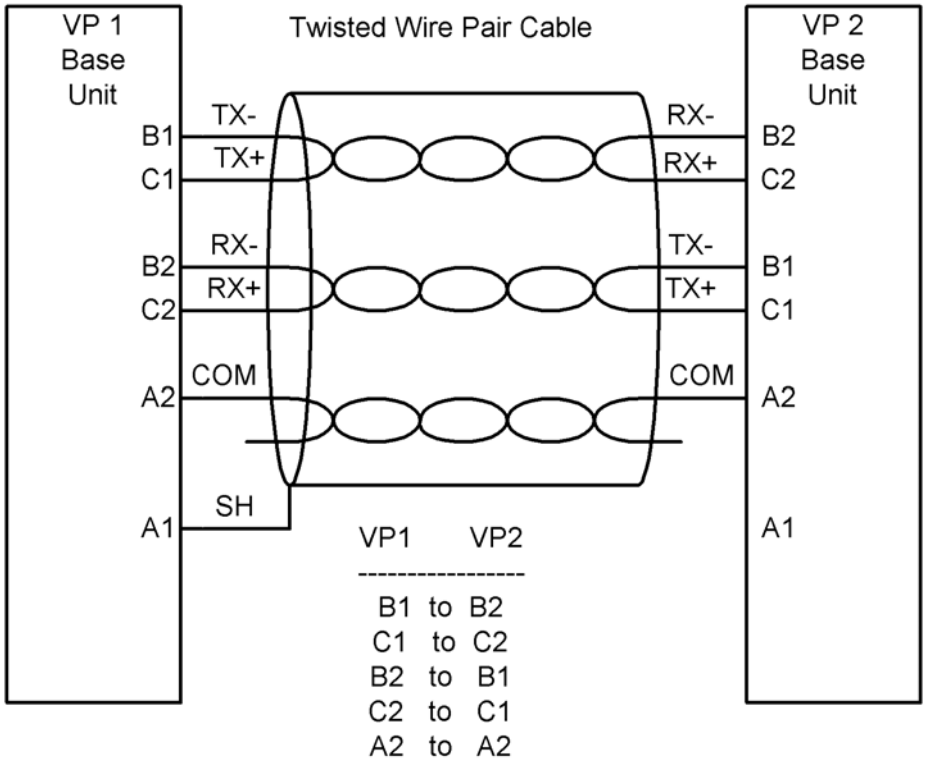


Figure 166: Redundant VP to VP Serial Connections

28.2 Module Group Information

28.2.1 Electronic Modules (EMODs)

There are two Electronics module groups for the Valve Positioner module:

- 1C31194G01 provides 17 Volts AC peak-to-peak 1 KHz LVDT drive.
- 1C31194G02 provides 23.75 Volts AC peak-to-peak 3 KHz LVDT drive.

Note: *When using the I/O Builder to configure the Valve Positioner (VP) module, note that whatever voltage/current description is displayed in the Slot position at the top of the window does NOT impact the configuration of the VP module.*

28.2.2 PERSONALITY MODULES (PMODS)

There are four Personality module groups for the Valve Positioner module:

- 1C31197G01 has 330 Ohm resistors that provide up to ±24.9 mA into 82 ohm servo coils. Use with any Valve Positioner Electronics module.
- 1C31197G02 has 360 Ohm resistors that provide up to ±16.8 mA into 250 ohm servo coils. Use with any Valve Positioner Electronics module.
- 1C31197G03 has 240 Ohm resistors that provide up to ±8.3 mA into 1000 ohm servo coils. Use with any Valve Positioner Electronics module.
- 1C31197G04 has 160 Ohm resistors that provide up to ±36 mA into 125 ohm servo coils. Only two coils may be driven by 1C31197G04. Use with any Valve Positioner Electronics module. The C3+ and C3- coil outputs are not available.

Note: *When using the I/O Builder to configure the Valve Positioner (VP) module, note that whatever voltage/current description is displayed in the Slot position at the top of the window does NOT impact the configuration of the VP module.*

Valve Positioner Subsystem [1]

RANGE	CHANNELS	ELECTRONIC MODULE	PERSONALITY MODULE
17 Volts AC peak-to-peak 1 KHz or 23.75 Volts AC peak-to-peak 3 KHz to an LVDT 24.8 mA into three 82 ohm coils	8	1C31194G01 or 1C31194G02	1C31197G01
23.75 Volts AC peak-to-peak 3 KHz or 17 Volts AC peak-to-peak 1 KHz to an LVDT 16.8 mA into three 250 ohm coils	8	1C31194G02 or 1C31194G01	1C31197G02
23.75 Volts AC peak-to-peak 3 KHz or 17 Volts AC peak-to-peak 1 KHz to an LVDT ± 8.3 mA into three 1000 ohm coils	8	1C31194G02 or 1C31194G01	1C31197G03
23.75 Volts AC peak-to-peak 3 KHz or 17 Volts AC peak-to-peak 1 KHz to an LVDT ± 36 mA into two 125 ohm coils	8	1C31194G02 or 1C31194G01	1C31197G04

RANGE	CHANNELS	ELECTRONIC MODULE	PERSONALITY MODULE

When using the Point Builder to define points for a Valve Positioner module, only the following point types are valid for each channel:

I/O Channel	Name	Type	Input Source or Output Destination	Terminal Block Connection [2]
1	Shutdown Status	Input	Valve Positioner	DI1
2	Auxiliary (wetting) Voltage Sense	Input	Valve Positioner	DI2
3	SLIM ON Signal	Input	Valve Positioner	DI3
4	Position Feedback	Input	Valve Positioner	
5	Coil 1 Voltage (Read-back)	Input	Valve Positioner	Coil 1
6	Coil 2 Voltage (Read-back)	Input	Valve Positioner	Coil 2
7	Coil 3 Voltage (Read-back)	Input	Valve Positioner	Coil 3
8	Raw Demodulator Voltage	Input	Valve Positioner	
9	VP Status	Input	Valve Positioner	
10	Demand Feedback	Input	Valve Positioner	
11	VP Command	Output	Valve Positioner	
12	VP Demand	Output	Valve Positioner	
13	Partner Position Feedback	Output	Valve Positioner	

[1] This module will provide an interface between an Ovation Controller and **ONE** Electro-Hydraulic (EH) servo-valve actuator in the field. To use this module, the MASTATION algorithm must reside in the Ovation Controller. (See the *Algorithm Reference Manual.)*

[2] The terminal block connection depends upon the application being used. Refer to wiring diagrams.

28.3 Module Specific Information

28.3.1 Firmware Levels

The table below lists all VP module firmware releases that added additional functionality to the VP.

VP Firmware Level (Electronics Module)	VP Revision Level (Electronics Module)	Firmware Features
0F	9	Added support for the following: ▪ Calibration from the Controller using graphics. ▪ Upload/download of calibration constants to and from the Controller. ▪ New tuning constants **kServo** and **kServoDb** to replace hard-coded constants. They add flexibility in dealing with differing coil impedances. ▪ Reduction of valve calibration time.
0C	6	Added support for VP Redundancy.
0B	5	First full production firmware release.
0D		Obsolete
0E		Obsolete
0G	11	Redundancy support changed so that multiple failovers are precluded. Improvements to calibration. Fixed problem with coil diagnostics for “coilCount = 0”. Position feedbacks rollover problem fixed.
0H	13	Added “priority Demand” tuning constant to support Rockport project. Fixed overflow problem in PI math.
0I	15	Corrected communications error in redundancy link.
0J	16	Added anti-windup feature, changed default values of piGain, pi ResetTDb, and errorDbs, and calibration sequence improvements.
0K	18	Fixed serial buffer lockup problem.

28.3.2 PRIMARY/BACKUP STATUS TRANSITIONS

Primary to Backup

If the VP is in the **Primary** mode, it will transition to **Backup** mode if:

- Serial Line Status is OK and Ovation Watchdog bit indicates partner is Alive, and is the primary (start condition).
- Partner is OK according to serial line data.
- Partner is OK according to Ovation data.
- Its own status is not OK.

Backup to Primary

If the VP is in the **Backup** mode, it will transition to **Primary** mode if:

- Its own status is OK and the partner's Ovation Watchdog Bit indicates Not Alive and Serial Line Status is not OK.
- Partner is in Backup mode, according to serial data.
- Partner is in Backup mode, according to Ovation data.

Setup Requirements

The following items must be set up before operating redundant Ovation Valve Positioner modules:

LVDT Setup

There are requirements on the LVDT setup for a redundant subsystem.

- First, the linear range of the LVDT must exceed the mechanical range. This means that when the valve is at either endpoint, one of the secondary voltages will be at its minimum. The secondary voltage must be large enough at the endpoint so that if a wire breaks and the secondary voltage goes to zero, the change of voltage will be large enough to be readily detected. A good guideline is to ensure that each secondary always contributes at least 10%, positive or negative, to the demodulated voltage. That is,

```
min (|A|, |B|) / (|A| + |B|) > 10%
```

  This minimum secondary value is expressed in percentage, is tunable, and is called MIN2NDRY.

- Second, the LVDTs must be calibrated prior to being placed into redundant service, and for all possible positions, the feedback signal of the Primary should be near the feedback signal of the backup. This value is called LVDTTRACKING, and its default value is 1%.

Coil Setup

Coil diagnostics rely on a steady voltage across the coil. This voltage will be present if you adjust the servo valve per the Emerson recommendation.

The servo valve has a mechanical bias set-screw that pushes the spool to one side, allowing fluid to escape the actuator and slowly close the valve in the absence of electrical excitation. In the standard setup approximately 200 mV across both coils opposes the mechanical bias adjustment and holds the spool in the center position, trapping the fluid in the actuator, and holding the valve in a fixed position. Adjusting coil current changes spool position so that current can flow into or escape from the actuator. (Technically, the operation of the servo valve is dependent on current through the coil and the mechanical bias adjustment. However, the VP is set up to measure voltage across the coil and at the amplifier output, so voltage measurements are typically referenced in this description.)

28.3.3 VALVE POSITIONER MODES

Rapid or erratic valve movement can damage the turbine. The Valve Positioner enforces a set of rules to accomplish bumpless transfer between modes. The description of each mode includes mode transfer.

Start Mode

When the Valve Positioner is powered-up or restarted, its primary objective is to avoid an indeterminate output that would result in valve movement, and possible damage to the valve or turbine. There are a number of hardware and software features that prevent an indeterminate output.

The hardware is designed so that when the Valve Positioner is powered-up, the power supply to the servo output is turned off. With no current flow to the servo valve, it is left under the influence of its mechanical bias adjustment, the assumed state prior to power-up. In addition, the coil drive D/A convertor is not turned on until it receives the first output pattern.

As part of the microcontroller's start sequence, the power supply is turned on, and then a pattern is written to the coil drive D/A convertor representing 0 volts. The result is that the servo output is under software control, no current flows between the Valve Positioner and the servo valve, and no valve movement has occurred.

The Valve Positioner will not remain in Start mode unless a diagnostic error is detected. The Valve Positioner transitions from Start to Local mode if all of the following functions execute and return "normal" or "ok" status codes:

- Program the FPGA.
- Go to Factory Configure Mode if PE pin is 1.
- Check PE pin. Go to Factory Test Mode, if required.
- EPROM checksum check.
- EEPROM checksum check.
- RAM read/write test.
- D/A convertor readback diagnostic.
- UART scratchpad read/write test.
- Shared memory readback check.

The Valve Positioner will set target valve demand equal to demand feedback before transferring to Local mode.

Local-Manual Mode

The purpose of **local-manual** mode is:

- Maintain stable valve position when the Controller fails or is reset.
- Smooth operation using manual raise/lower function.
- Bumpless transfer to normal mode. (Tracking by the Controller is required, and is enforced by the Valve Positioner in local-manual mode.)

In local-manual mode, the Valve Positioner controls the valve using a set point that is only changed through the SLIM interface, or through the local serial interface.

Local-manual mode will be entered from normal mode if the Controller fails or stops updating the Valve Positioner card. When the Valve Positioner is powered up, local-manual mode is always entered as long as there are no diagnostic failures.

The preferred mode of Valve Positioner operation is normal mode. The Valve Positioner transfers from local-manual to normal if the following conditions are met: (1) Controller is updating the set point, thus keeping the watchdog timer from expiring. (2) Controller is tracking.

In local-manual mode, the following functions are performed:

- PI position control loop.
- Writes current valve position to Ovation memory.
- Writes coil voltages to Ovation memory.
- Open coil diagnostic.
- Shorted coil diagnostic.
- EPROM checksum diagnostic.
- RAM diagnostic.
- Watchdog timing.
- SLIM interface (Raise, Lower, and update SLIM values.)
- Valve contingency diagnostic.

Normal Mode

Normal is the preferred mode of the Valve Positioner card. In normal mode, the Valve Positioner is receiving a position set point from the Controller and controlling valve position.

In normal mode, the following functions are performed:

- PI position control loop (Demand position comes from the Controller via the Ovation memory).
- Writes current valve position to Ovation I/O memory.
- Writes coil voltages to Ovation I/O memory.
- Open coil diagnostic.
- Shorted coil diagnostic.
- EPROM checksum diagnostic.
- RAM diagnostic.
- Watchdog timing.
- SLIM interface (Updates SLIM values, no raise/lower function.)
- Valve contingency diagnostic.

Calibrate Mode

Calibrate mode is a submode of local-manual mode. Calibration sequences are commanded through the local serial port.

The Valve Positioner is commanded to calibrate when the appropriate bit in the command word is set. This causes the Valve Positioner to enter the calibrate mode and begin its travel sequence. During the travel sequence, the Valve Positioner will report a position feedback calculated using the most recent calibration numbers. The controlling MASTATION will enter manual mode and track the position demand feedback. The Valve Positioner moves the valve at a programmable rate during the travel sequence.

The Valve Positioner can exit calibrate mode **without** enforcing a bumpless transfer rule.

The following calibrate sequences are supported:

- Zero Hot Cal

  This calibration sequence is executed to re-establish the 0% position. It is useful after the valve has been fully calibrated and the mechanical assembly has been heated and expanded. It avoids fully opening the valve.

  Feedback gain is not adjusted during the hot cal sequence.

- Top Hot Cal

  This calibration sequence is executed to re-establish the 100% position. It is useful after the valve has been fully calibrated and the mechanical assembly has been heated and expanded. It avoids fully closing the valve.

  Feedback gain is not adjusted during the hot cal sequence.

- Null-Point Cal

  This calibration sequence causes the valve to travel to the electrical null point of the LVDT. Null point calibration can be requested at the same time as full calibration, in which case the movement sequence is the full calibration sequence. However, the valve stops at the null point when it is encountered.

- Full Calibration

  This calibration sequence is executed to re-establish 0% position, 100% position, and feedback gain.

  When full calibration is requested the module enters local mode, requiring the Controller to track. The module then moves the value to the 0% position. The firmware checks for position feedback between the arbitrary limits of –9.7 volts and –2.0 volts. If the voltage is less (more negative) than –9.7 volts, the firmware reduces gain to make the voltage more positive than –9.7. If the voltage is more positive than –2.0 volts, the gain is increased until the voltage is more negative than –2.0 volts. During these two sequences, the gain is tested to insure it does not go out of allowable range.

  If the voltage is between –9.7 and –2.0, then gain is recalculated to set the voltage to the arbitrary target voltage of –0.35 volts, and the firmware sequence advances to the next state, which will take the value to 100%.

  At this point in the sequence, the demodulator gain has been set to a value that is a maximum allowable value. The gain may be reduced at the other end of the stroke, but will not be increased.

  Now the valve moves to the 100% position. The feedback voltage is examined, and if it exceeds 10.0 volts, feedback gain is reduced. Once feedback voltage is less than +10.0 volts, it is recorded as the 100% calibration value.

  The valve moves back to 0% and the voltage at 0% is recorded. Feedback gain is not adjusted.

  The last step is to write 0% position, 100% position, and feedback gain to the EE memory.

  Once the data is recorded in EE memory, the firmware clears a restriction flag, allowing the module to transfer from local mode back to normal mode. At this point the valve is under the control of the MA station and will return to the previous position according to the tuning of the MA.

28.3.4 CONTROLLER INTERFACE

This section defines direct-access Ovation shared memory registers from the Controller point of view. The Controller point-of-view is at the internal workings of the algorithm (the MASTATION is assumed). Conversions may occur between the applications level and the level described here. This format is used for start up, local, and normal operating modes. In test mode, the format changes except for the mode bits in register 6 (status register 1), Bits 0 through 3, and the FIFO control bits in both the command register and status register 2.

Memory Map

The table below describes the Controller registers for the Valve Positioner module, and also defines the I/O Channel Number that must be selected in the Point Builder Hardware Tab (shown below) when configuring points associated with this module (See the *Ovation Point Builder User Guide* or *Ovation Developer Studio User Guide*.)

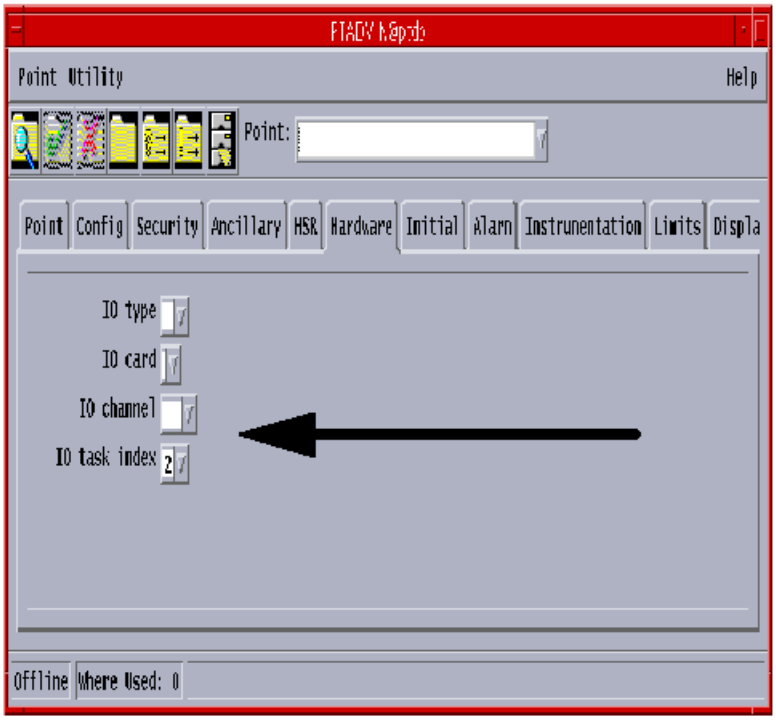


Figure 167: Point Builder Hardware Tab

Use the information in the table below to determine how to scan the card and retrieve card status bits. The status bits will influence your control strategy.

Operating Mode Memory Map

VALVE POSITIONER CARD REGISTER	I/O CHANNEL NUMBER IN THE POINT BUILDER	R/W	DEFINITION
0	N/A	N/A	Indirect ram pointer (Output FIFO Put Pointer)
1	N/A	N/A	Indirect ram data register
2	4	R	Position feedback (-1560 to 32760 equals -5.0 to 105%)
3	5	R	Coil voltage 1 (traditionally called S1)
4	6, 13	R, W	Coil voltage 2 (traditionally called S2) (non-redundant configuration only)
5	7	R	Coil voltage 3 (non-redundant configuration only)

VALVE POSITIONER CARD REGISTER	I/O CHANNEL NUMBER IN THE POINT BUILDER	R/W	DEFINITION
6	8	R	Raw demodulator voltage
7	N/A	R	Status Word 2 **Bits 0 - 15:** Not used.
8	9

VALVE POSITIONER CARD REGISTER	I/O CHANNEL NUMBER IN THE POINT BUILDER	R/W	DEFINITION
9	10	R	Demand feedback (-1560 to 32760 equals -5.0 to 105%) = (Position feedback - bfpB) / bfpM (bfpM and bfpB are described below) For non-boiler feed pump applications, bfpM = 1.0 and bfpB = 0.0, therefore “Demand feedback” and “Position feedback” are exactly equal.
A	11	W	Command Register **Bits 1 - 2**: calibration requests 000 = no request 001 = zero hot cal request 010 = top hot cal 011 = full calibration 100 = go to null point 101 invalid 110 invalid 111 = full calibration and stop at null point **Bit 3**: Not used **Bit 4**: Partner Quality (redundant VP configuration) 0=OK, 1=BAD **Bit 5:** Partner Alive Bit (redundant VP configuration) from register 8, bit 7 or Partner VP **Bit 6**: Redundant VP’s Partner’s Primary/Backup Status. The Controller copies Bit 10 from the partner’s status register 1 to inform the VP that the partner is a Primary or Backup drop. **Bit 7:** Not used **Bit 8**: Arm RVP. When this bit is set, the backup RVP is re-armed and can take over control if the primary fails. When a backup RVP is disarmed, it will not take over control for certain types of failures. **Bits 9 - F**: Not used
B	12	W	Demand (-1560 to 32760 equals -5.0 to 105.0%)
C			Point Status Register
D		R/W	Module Configuration Status Register (see page 470)
E		R	Secondary Module Configuration Status Register (see page 471)
F			Electronic ID

28.3.5 CONFIGURATION COMMANDS

The following commands are used to set the values of important tuning constants. The format of each command is indicated and must be followed. The values shown for each command are default values.

Configuration Commands

<table>
<tr><th>COMMAND</th><th>DESCRIPTION</th></tr>
<tr><td>piGain = 10.0</td><td>PI Controller gain outside of deadband. This value is the higher of two gain values used in the position PI loop. This value is used when the valve is moving. When the valve is in a stable position, a lower value is used to avoid noise-induced control action.</td></tr>
<tr><td>piResetT = 1000</td><td>PI Controller reset time outside of deadband. Used in PI equation along with the gain value described previously. This value is one of two used in the PI equation. This one is used when the valve is in motion, and causes faster wind-up. It is given in milliseconds.</td></tr>
<tr><td>piGainDb = 1.0</td><td>PI Controller gain inside of deadband. When the valve is in a steady position, the PI gain is reduced to this value. This helps avoid noise-induced control action.</td></tr>
<tr><td>piResetTDb = 10000</td><td>PI Controller reset time inside of deadband. This is one of two values used, and causes slower control action. It is given in units of milliseconds.</td></tr>
<tr><td>demodGain = 2048</td><td>The LVDT secondary feedback sum is multiplied by this value to achieve a voltage range representing 0 to 100% position that is close to the input range of the A/D converter. The value is printed as a raw decimal value. The hexadecimal equivalent is written to the feedback D/A converter to adjust feedback gain. This value can be entered by the customer, but it is also modified automatically during the full calibration sequence. Feedback gain can be calculated by the following formula:
gain = 4096 / D/A converter input word (decimal value)
Examples of some gain values are as follows:
<table>
<tr><th>DAC word</th><th>Decimal value</th><th>Gain</th></tr>
<tr><td>0</td><td>0</td><td>Infinity [1]</td></tr>
<tr><td>1</td><td>1</td><td>4096</td></tr>
<tr><td>.</td><td>.</td><td>.</td></tr>
<tr><td>8</td><td>8</td><td>512</td></tr>
<tr><td>.</td><td>.</td><td>.</td></tr>
<tr><td>100H</td><td>256</td><td>16</td></tr>
<tr><td>.</td><td>.</td><td>.</td></tr>
<tr><td>800H</td><td>2048</td><td>2</td></tr>
<tr><td>.</td><td>.</td><td>.</td></tr>
<tr><td>FFH</td><td>4095</td><td>1.00024</td></tr>
</table>
[1] Feedback gain D/A converter output saturates.</td></tr>
<tr><td>errorDbF = 0.5</td><td>When the absolute value of the difference between target position and actual position is greater that this value, the valve is considered to be in motion. Gain and reset values are selected to cause rapid control action. When the difference is less than this value, control action is softened.</td></tr>
</table>

COMMAND	DESCRIPTION
errorDbS = 0.05	When the absolute value of the difference between target position and actual position is less than this value, the valve is considered to be stable. Gain and reset values are selected to soften control action. When the difference is greater than this value, gain is increased to yield sharper control.
seatLimit = 0.0	When target valve position is equal to or less than this value, seating action controls the output.
backSeatLimit = 100.0	When the target valve position is equal to or greater than this value, backseating action controls the output.
contingency = 5.0	If the absolute value of the difference between Valve Positioner target position and actual position is greater than this value, then a contingency condition may exist. The condition must exist until a timer expires for it to be reported. The timer is described below. A situation could arise where the Valve Positioner target position and the Controllers' target are not equal. One example would be if the shutdown input was true, the Valve Positioner set the target position to 0, but the Controller did not track. In this situation contingency would not be reported if the valve went to 0% position.
contingencyTime = 10000	If the error between target position and actual position exceeds contingency for this amount of time, then the condition is reported to the Controller. This number is given in milliseconds.
manualRate = 300	This value selects the magnitude of adjustment when target position is controlled by the SLIM. This value is given in percent per minute.
bfpM = 1.0	Gain in the equation **y = bfpM * x + bfpB** where y = actual demand; x = demand written by the Controller The purpose of this is to create staggered valve operation in the boiler feed-pump application. This value is normally set to 1.0.
bfpB = 0.0	Zero intercept in the equation **y = bfpM * x + bfpB** where y = actual demand; x = demand written by the Controller The purpose of this is to create staggered valve operation in the boiler feed-pump application. This value is normally set to 0.0.
SlimAddr = 0	Each device on the SLIM serial bus has an address. This provides a method for the SLIM to talk individually to each card. The SLIM serial port is used for redundancy serial communications. Setting the address to zero (0) disables SLIM transmit/receive code.
calhndrd = 31200	This value is displayed in decimal. It is the converted hexadecimal A/D converter reading for the 100% position. It can be entered by the customer; however, it is normally determined automatically by the calibration sequence.
calzero = -31200	This value is displayed in decimal. It is the converted hexadecimal A/D converter reading for the 0% position. It can be entered by the customer; however, it is normally determined automatically by the calibration sequence.

COMMAND	DESCRIPTION
calrateF = 1664	This value is given in percent per minute and is the movement rate used when calibrating from the Laptop computer via the serial port. It is typically the **F**aster rate.
calrateS = 1664	This value is given in percent per minute and is the movement rate used when calibrating via a command from the Ovation I/O interface. It is typically the **S**lower rate. **Note** *When the raise/lower button is pressed, the Valve Positioner will respond to the keystroke if the address is 1 through 8 inclusive. This means that all valves will move together.*
posErrDelta = 5.0	A tunable parameter which sets a limit for the difference between target and actual position. When the difference is greater than this limit, POSITION ERROR FLAG is set TRUE, otherwise it is FALSE. This variable is similar to **contingency** except that it is devoted to the redundant calculations.
maxdelta = 5.0	A tunable parameter which sets a limit for the difference between position feedback and previous position feedback. The default value is 5%. Expressing the value as a derivative would yield 5% per 10 msec (= looptime) or 500% per second. This value is intended to represent the maximum rate of movement of the valve. This value has a function similar to MIN2NDRY. It is assumed that MAXDELTA will always be the smaller of the two.
min2ndry = 5.0	The minimum secondary value is similar to MAXDELTA because it represents a position feedback derivative. However, MIN2NDRY describes the minimum value in percent of a contribution of either secondary signal. If the secondary wire were to break, position feedback would suddenly change by at lease this amount. The default value is 10%. If the difference between position feedback and previous position feedback were to change by this value, or greater, it suggests a broken secondary wire. It is assumed that MIN2NDRY is larger than MAXDELTA.
lvdtTrack = 1.5	The maximum difference between LVDT readings in a redundant configuration.
RDNDNT	If RDNDNT = 0, the VP is a standalone module If RDNDNT = 1, the VP is a redundant module This is the MOST important constant and MUST be set prior to inserting the VP into its mounting slot. If the VP is installed without this constant being set, and the unit is on line, the results are unpredictable. In some cases, such as when a VP module is being replaced by another VP from stock, the VP should be placed into an unused slot to power it up and modify the constant. Remember to type `SC` to save the constants to EEPROM memory. Setting this constant changes the Baud Rate for COM Port 2 (SLIM port) to 25 k baud.
demand = 10.0	This command sets target value position to 10%, sets the VP made to local, and sets a restriction bit to prevent the VP from entering Normal mode. Type “EXIT” to clear the restriction bit.
CoilCount = 2	If CoilCount = 1, the VP is a redundant module and only coil 1 from the VP is used. Failure to set this constant will typically result in servo coil diagnostic failures, which cause the VP to fail to its Backup. If CoilCount = 2, coils 1 and 2 are used, and coil 3 (diagnostic) is disabled.
diagtime = 20	Timer value in millisecond increments for the coil short/open timer. The conditions must exist for this amount of time before it is reported to the Controller.

COMMAND	DESCRIPTION
diags	Displays status information in hexadecimal format. Included is the operating mode, restrictions, signals, and Severe Fatal Errors (SFE) bits. The following message is displayed: mode=0xmmmm restrictions=0xrrrrrrr signals=0xssss sfe's=0xeeee where mmmm = Hex value of operating mode: 0 through 0x05 are **start** modes 0x14 through 0x19 are **local** modes 0x28 through 0x2B are **normal** modes 0x3C through 0x3F are **test** modes rrrrrrr = Restriction bit array: **Bit 0** - PROM checksum error **Bit 1** - Memory diagnostic error **Bit 2** - A/D, D/A subsystem error **Bit 3** - Contingency restriction **Bit 4** - Ovation I/O not configured **Bit 5** - Constants are mismatched **Bit 6** - Controller is not updating **Bit 7** - Controller is not tracking **Bit 8** - EEPROM checksum error **Bit 9** - Hold until oscillator is stable **Bit 10** - Serial port control (local mode) restriction ssss = Signal flags: **Bit 0** - Coil 1 diagnostic **Bit 1** - Coil 2 diagnostic **Bit 2** - Coil 3 diagnostic **Bit 3** - DAC diagnostic **Bit 4** - Coil 1 open **Bit 5** - Coil 1 short **Bit 6** - Coil 2 open **Bit 7** - Coil 2 short **Bit 8** - Coil 3 open **Bit 9** - Coil 3 short **Bit A** - AD/DA error **Bit B** - Contingency **Bit C** - Repetitive display **Bit D** - Raise pushbutton on SLIM **Bit E** - Lower pushbutton on SLIM eeee = Severe fatal error bits: **Bit 0** - EEPROM checksum **Bit 1** - PROM checksum **Bit 2** - Shared memory error **Bit 3** - Processor memory error **Bit 4** - FPGA won't program **Bit 5** - UART readback error **Bit 6** - Processor error **Bit 7** - AD/DA error **Bit 8** - PSD memory error **Bit 9** - EE write sequence error

COMMAND	DESCRIPTION
kServo = 20.0	kServo is a parameter, given in percentage, that models the impedance relationship of the Personality module (PMOD) and the servo coil. For example, if the user has a PMOD with an impedance of 300 ohms, and the coil impedance is 82 ohms, then kServo should be set to 21.0 or 82 / (300 + 82). VP diagnostic firmware uses this parameter to predict coil voltage based on amplifier output voltage. Wire impedance is included in coil impedance. The user can take a direct measurement with a standard voltmeter by removing the VP from the base unit. The user can also measure the ratio directly. One method is to measure amplifier output voltage at B13, a coil output that is normally unconnected, then measure coil voltage at B14 or B15. With the unit off line, amplifier voltage at B13 would be saturated to 10 volts or 5 volts depending on the state of the current reduction algorithm. This parameter can be used when servo coils are wired in parallel. For this example, kServo would be set to 11.7 or 40 / (300 + 40). If one of the coils burned out, the relationship would change to 21.0. By setting kServoDb to 5.0, an alarm would be generated when the servo coil went open circuit.
kServoDb = 5.0	Deadband value used to calculate the allowable coil voltage range when comparing predicted voltage to actual voltage.
priorityDemand = -5.0	For firmware revisions 0H and later, “priorityDemand” is the target position used when the shutdown input is activated. The default value is selected so that upgraded modules are backward compatible. The user can set this value to an intermediate value in order to create his own scheme for handling of plant upsets.

28.3.6 SLIM (SMALL LOOP INTERFACE MODULE) INTERFACE

A standard SLIM (see page 407) is used to control a group of valves on a common serial bus).

Modes

The SLIM has four modes:

- Local
- Auto
- Cascade
- Manual

Only two of the four (local and auto) correspond to Valve Positioner modes. **Local mode** corresponds to Valve Positioner **local-manual** mode. However, the operator does not request "local' mode." It is only entered when the Controller stops or fails to update the Valve Positioner card.

SLIM **auto mode** corresponds to Valve Positioner **normal mode**. In this mode, the Controller is writing its desired position to the Valve Positioner. In normal mode, the valves' position and set point can be viewed on the SLIM, but the SLIM has no control over the Valve Positioner.

These modes should not be confused with auto and manual modes of software loops within the Controller. The important thing to remember is that the Valve Positioner is always in normal mode, receiving its position from the Controller, unless the Controller fails, in which case the Valve Positioner switches to local mode.

When raise and lower on the SLIM are pressed, all Valve Positioners respond to the key action. This means that all valves will move together as a group. It also suggests that no other devices (Loop Interfaces) should be connected on the serial bus with a group of Valve Positioners.

In abnormal situations, such as during maintenance, some valves may be in normal mode, and some may be in local mode. In this situation the valve in local mode will respond to raise/lower action, but the valves in normal mode will not. The Controller application will warn or notify the operator of the mode of each valve.

Since the SLIM will be connected to a group of Valve Positioners, each Valve Positioner must control its own transmit enable. Each SLIM enables its transmitter when placing a response into the transmit buffer. It also starts a 25 mSec timer, which, when expired, disables the transmitter.

SLIM PUSHBUTTONS

The purpose of this section is to highlight and clarify SLIM operation as it differs from normal operation when connected to the Ovation Loop Interface.

The actions that occur when a SLIM pushbutton is used are described in the table below.

SLIM Pushbutton Actions

BUTTON	DESCRIPTION
Loop	The next Valve Positioner on the serial bus is selected. Set point and target position are displayed on the vertical bargraphs.
Display	Display cycles the top left hex display from target position, actual position, and servo voltage output.
Up	Up increases target valve position for the valve group. Only the valves in local mode respond to the Up button.
Down	Down decreases target valve position for the valve group. Only the valves in local mode respond to the Down button.
Manual, Auto, Cascade, Mode, Left, Right	Not used.

The SLIM indicators and LEDs provide information about the operation of the Valve Positioner.

SLIM Indicators and LEDs

INDICATOR	DESCRIPTION
PV Bargraph	Indicates actual valve position
SP Bargraph	Indicates target valve position of the selected valve
Output Bargraph	The horizontal output bargraph on the bottom of the SLIM indicates servo output voltage ranging from -10 volts to +10 volts, mapped to 0 to 100% available on the bargraph. For a stable valve in a controlled position, approximately 50% (+/- mechanical bias adjustment) would be indicated.
Top Left digits	Indicators for set point, actual, or output voltage.
Top Right digits	Indicate engineering units of the value being displayed.
LEDs: M, C, and T	In local manual mode, C (control) is indicated. In normal mode, M is indicated (monitor). The operator does not have any control over the ‘M’, ‘C’ or ‘T’ function.
LEDs: Casc and Man	Not used.
Auto LED	Illuminated if the valve is in **normal** mode.
Loc LED	Illuminated if the valve is in **local** mode.

28.3.7 VALVE POSITIONER CONTROL

In normal, local, and calibrate modes the Valve Positioner is always controlling valve position. The PI routine runs unconditionally every 10 msec. Typically, it will execute the PI equation as described below. The PI routine has some conditionally executed parts to handle seating and backseating.

Seating and Backseating

Seating and backseating are important features of valve position control. The purpose of seating is to ensure that the hydraulic system is forcing the valve closed and admitting no steam into the turbine. Backseating is desirable because it can affect efficiency, and because, for certain valve assemblies, a leakoff into other steam systems are designed, assuming the valve is fully backseated.

The demand position from the Controller to the Valve Positioner is designed for a range of -5% to 105% and resolution exceeding 13 bits. Seating is in effect when the position demand is equal to or less than a programmable value, typically 0%, and actual position feedback is less than 5%. When seating is in effect, the output is driven to the maximum possible value in the direction that closes the valve. A timer is started. After 10 seconds, the output is reduced to 50% of the maximum value in the direction that closes the valve. A similar limit and function is provided for backseating.

With revision J, the behavior of backseating has changed, and an anti-windup feature is implemented that affects both seating and backseating.

With revision J and beyond, when the VP is seating or backseating, the integral accumulation is set to 0. The result is that when the target position returns to the normal operating range (seatLimit < targetPosition < backSeatLimit), the output voltage is 0.0 (plus proportional adjustment). In other words, the output voltage will jump to 0.0 and not require integration to bring the output back to a controlling value.

In conjunction with the straight line adjustment (implemented using bfpM and bfpB) of target position, a soft landing is implemented for backseating. When the target position exceeds backSeatLimit, the physical target position is ramped to the physical 100% position. At this point, the output voltage goes to 50%. The 10 seconds timing function is not implemented.

PI POSITION CONTROL

The equation for PI position control is:

$$K_p\left[e(t)+\frac{1}{k_i}\int e(t)dt\right]$$

where:

Kp = Proportional gain

KI = Integral time

e(t) = Position error

If seating or backseating is in effect, normal PI Controller calculation is halted.

SHUTDOWN INPUT (PRIORITY DEMAND INPUT)

Position control is affected by a shutdown input, intended to be used in emergency or abnormal situations. It is a standard 24 volt digital input circuit.

Typically, the Valve Positioner will rapidly drive the valve to the 0% position when the shutdown input is energized. The Valve Positioner then transfers to **local-manual mode** for the purpose of requiring the Controller to track position feedback. Once the Controller tracks, the Valve Positioner will transfer back to **normal** mode.

The state of the shutdown input is available to the Controller via a Valve Positioner module Ovation register.

A control bit in the shared memory can cause the Valve Positioner to ignore the shutdown input while in **normal** mode. This is used when the customer prefers trip logic in the Controller, not on the card. However, in **local-manual** mode, the Valve Positioner will drive the valve shut when the shutdown input is energized, regardless of the state, or previous state, of the control bit.

For VP firmware revisions 0H and later, the shutdown input is redefined to “Priority Demand Input.” When the input is activated, the target position is set to a tunable constant. For compatibility with previous firmware revisions, the default value of priority Demand is -5%.

This allows the user to rapidly move the valve to some intermediate position during upset conditions. The user has the flexibility to create his own scheme to handle an upset.

While the “priority demand input”, or “Shutdown” input is active, the VP is in the local mode and the controller must unconditionally track demand feedback.

28.4 CALIBRATION

28.4.1 PERFORMING CALIBRATION USING THE SERIAL PORT

Using the Serial Port for Calibration, Settings

The local serial port is used in the field to calibrate and diagnose Valve Positioner problems. It is used in the factory to cause the Valve Positioner to perform necessary testing prior to shipment. This interface is implemented using the external UART.

The settings of the local serial port are:

- Baud rate = 19200
- Bits = 8 bits
- Stop Bits = One stop bit
- Parity = No parity

Status messages are printed during calibration sequences, such as:

```
'Calibrate - Go to 100%'
```

OR

```
'Calibrate - Reduce feedback gain'
```

WARNING! The EE memory can be corrupted if constants are modified during the calibration sequence. This occurs because the checksum is recalibrated based only on new values for 0%, 100% and feedback gain, not on the entire EE memory image.

Using the Serial Port for Calibration, Connections

The Personality module RS-232 connector is used to connect the Valve Positioner module to the COM1 or COM2 serial port of a personal computer.

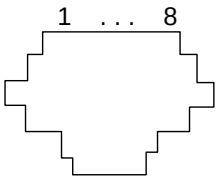
Use cable **5A26448** or make a cable using the information in the table below.

RS-232 Connector (J2) Pin Assignments

PIN NUMBER	SIGNAL NAME (FUNCTION)	SIGNAL DIRECTION
1	Not used	Not used
2	Not used	Not used
3	TXD2/ (Transmit Data)	Output
4	Not used	Not used
5	RXD2/ (Receive Data)	Input
6	GND (Logic Common) [1]	Not used

PIN NUMBER	SIGNAL NAME (FUNCTION)	SIGNAL DIRECTION
7	Not used	Not used
8	Not used	Not used

Front View of J2 Connector (Modular Jack)



1 This serial port is not electrically isolated from logic ground.

Performing Calibration

Calibration is performed by connecting a PC (running terminal emulation software) or a dumb terminal to the Valve Positioner, then typing commands on the PC keyboard or terminal. Using a PC is recommended because you can record/reload tuning constants to/from a disk.

The goals of calibration are:

- To determine the endpoints of mechanical stroke.
- Help the plant set up the LVDT for optimum performance.
- Perform the calibration quickly to avoid startup delay.

CALIBRATION REQUIRED

Calibration is required after the following:

- After a mechanical overhaul

  If the mechanical stroke remains the same after the overhaul, and the same LVDT is installed, simply adjust the LVDT so the position feedback on the Ovation system indicates 0% (with the valve fully closed), then tighten down the LVDT assembly (that is, return to its former position).

- After the LVDT is changed

  Calibration is required to find the null point and proper demodulator gain adjustment. However, if it is the same model, time can be saved by entering the same constants before running the calibration sequence.

- If a secondary wire pair is swapped

  The valve positioner is not affected because the demodulator is a diode rectifying type. Also, the secondary pairs (A and B), can be swapped. The result will be a change in sign of the calibration values. Arithmetic in valve positioner firmware will yield the correct result. However, the user should follow the recommended hookup that will yield negative values at 0% and positive values at 100%, and avoid confusion.

CALIBRATION IDEAL

During the calibration sequence, observe the valve to ensure it is moving, and that it is moving in the proper direction. Also, review the calibration constants and compare them with the ideal setup described below:

- The range of calibration values corresponds to the hexadecimal range of the AD converter, and is presented to the user in decimal, ranging from -31768 to 31767.
- When an LVDT is properly adjusted and calibrated, the calibration constants (0% and 100%) will be equal in amplitude and opposite in sign. The amplitudes for this ideal setup would be approximately 30,000. This result suggest the following:
  - The LVDT is adjusted so that its electrical null point (where secondary A amplitude = secondary B) matches the midpoint of the mechanical stroke.
  - The programmable gain amplifier on the demodulator is adjusted so that the electrical 'stroke' stays within the input range of the AD converter. Thus, the valve positioner can detect incremental movement for all valve positions.
  - If thermal expansion occurs, the valve positioner will continue to detect incremental movement, because the calibration is not to the extreme end of the AD converter range, and because the magnitude of thermal expansion is small.

TO SIMPLIFY DIAGNOSTICS

Rolled servo wires can cause the valve to move in the opposite direction. Be sure to observe and verify the correct movement of the valve. If only one pair is rolled, then the two pairs will be “fighting” each other. Use the following procedure to simplify diagnosis:

1. Disconnect one pair of wires.
2. Calibrate the valve, verifying the correct movement of the valve.
3. Reconnect the first pair of wires.
4. Disconnect the other pair of wires.
5. Calibrate the valve, verifying the correct movement of the valve.
6. Reconnect all the servo wires.
7. Calibrate the valve, verifying the correct movement of the valve.

ON-BOARD DIAGNOSTICS

The mechanical bias adjustment of the servo valve can affect the results of on-board diagnostics. A set-screw on the servo valve causes a deflection from center position of the servo valve spool. This allows hydraulic fluid to escape the actuator, and the valve to close at controlled rate, in the absence of an electrical signal.

For a typical hookup, a small negative voltage on the servo valve is required to center the spool, and hold the valve in a steady position. This voltage is typically from -100 to -300 mV. Servo valves are delivered from the factory with this adjustment. On board diagnostics assume that the servo valve is set up in this way. If another setup is used, program the Ovation Controller to ignore the results of diagnostic bits.

WARNING - NOTES FOR GE 4-WIRE AND 5-WIRE SINGLE LVDT CONNECTIONS

The VP can detect position if only a single LVDT feedback signal is connected. The inputs of the unused LVDT input should be grounded to avoid picking up noise.

If LVDT A is connected, the 0% and 100% calibration constants will both be positive. If B is used, both constants will be negative.

GE style 4-wire and 5-wire LVDTs with 1 feedback can be connected so that 0% position is the high amplitude voltage (absolute value) and 100% is the low amplitude voltage. This is the desired connection since, in the event of a failure or broken wire, the VP will see a low voltage, assume the valve went open, and respond by closing the valve.

An alternate hookup can be implemented where 0% corresponds to the low amplitude voltage, and 100% corresponds to high amplitude. There are 2 problems with this setup.

1. Upon failure and loss of signal, the VP will attempt to open the valve to the target position because the valve appeared to close inappropriately.
2. During calibration the sequence starts at 0%, where the demodulator gain is raised until the feedback reaches the limit of the AD converter. The result will be a very high gain because the voltage at 0% is so low. Then, when the valve is moved to 100%, the voltage into the AD converter will be out of range, and the degree to which it is out of range is not detectable. The sequence will take a very long time to reduce the gain until the signal is usable, and the customer will be required to wait.

For a single LVDT hookup, the customer should complete the hookup, calibration, and then do the following test:

Set the valve position to an intermediate position, say 20%. Disconnect the oscillator wire. The valve should go closed.

TO PERFORM THE CALIBRATION PROCEDURE USING THE SERIAL PORT

1. Use a standard cable to make the connection (see page 451) between the PC (or dumb terminal) and the Valve Positioner.
2. Configure the serial port on the PC as described in “Settings (see page 451).”
3. To run a calibration sequence, perform the following:
   a) A. Hook up the serial cable between the COM port and the user port on the Valve Positioner.
   b) B. Start the terminal emulation software.
   c) C. Ensure the settings are correct.
   d) D. Type `HELP<return>` (See the table below).

   Note the following:

   - ☐ Commands are case sensitive.
   - ☐ Syntax is strict.
   - ☐ There is no line buffering.
   - ☐ Backspace invalidates any typed command.
4. Type **`CALFULL<return>`** to run the full calibration sequence.

5. If any constants are entered manually, type **SC<return>** to save the new constants to the EEPROM.
6. Use the command **CALFULL** after an overhaul, to fully calibrate the valve.
7. Use the command **CALBOT** just prior to startup, to reestablish the 0% calibration value if thermal expansion is detected.

Calibration Commands

COMMAND	DESCRIPTION
DC<return>	Dump configuration constants from EEPROM.
SC<return>	Save configuration constants to EEPROM.
DG<return>	Display group 1 data - This function would repeatedly display important operating parameters such as demand, feedback, gain, and so forth.
HELP<return>	Print command list.
EXIT<return>	Exits test mode, raise/lower function, or calibration sequence. Causes a soft reset of the valve positioner.

28.4.2 PERFORMING CALIBRATION USING A GRAPHIC

Calibration can be performed by using the Valve Positioner Upload/Download/Calibrate graphic (diagram 8719) to view and modify the VP tuning constants. All the constants can be modified. The 0% and 100% calibration values, and demodulator gain, can be determined by the calibration sequence, and can be adjusted by the user with this graphic.

The graphic has upload/download buttons so that the two sets of numbers can be synchronized (made the same). This synchronization is initiated by the user and is the responsibility of the user. In addition to the constants, there are four fields that provide operator feedback.

The constants exist in two places:

- EE memory on the Valve Positioner module.
- In the VPSTATUS algorithm record (typically, the constants contained in the algorithm record are considered as the master set).

If a VP module fails and is replaced, the user simply downloads the constants to the new VP and it is ready to operate. The constants are not automatically copied to the algorithm record upon completion of a calibration sequence.

Note: *Each constant shown on the graphic can also be entered through a serial port interface* *(see page 452).*

Calibration Goals

The goals of calibration are:

- ☐ To determine the endpoints of mechanical stroke.
- ☐ Help the plant set up the LVDT for optimum performance.

☐ Perform the calibration quickly to avoid startup delay.

TO PERFORM A CALIBRATION USING A GRAPHIC

1. Access a turbine valve graphic. The turbine valve graphic shows a list of all the turbine valves.
2. Click on the desired valve symbol to display the VP calibration graphic and show the constants associated with that particular VP and valve. This graphic is provided with the project graphics. Customizing of the turbine valve graphic and VP calibration graphic is not in the scope of this document.
3. Perform the desired calibrations. All the calibration procedures cause the VP to enter local mode. While the VP is calibrating in local mode, VP firmware adjusts target demand accordingly. The Controller unconditionally tracks the VP when it is in local mode.
4. Refer to the table below for descriptions of the graphic fields.

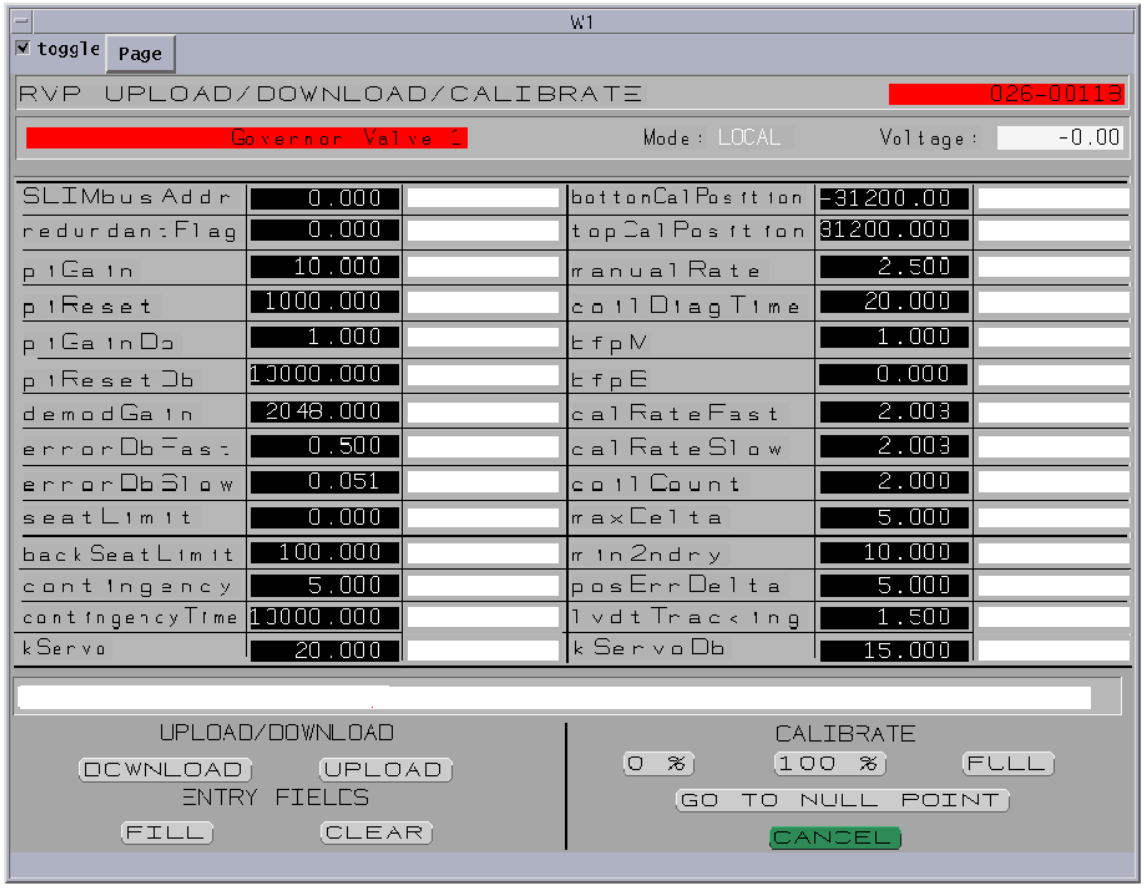


Figure 168: VP Upload/Download/Calibrate Graphic

Calibration Graphic Fields

Field	*Description*
CALIBRATE Buttons	
0%	This button executes the CALZERO procedure. Demodulator gain is not adjusted during this procedure. When this procedure is completed, upload the calibration data to the algorithm.
100%	This button executes the CAL100 procedure. Demodulator gain is not adjusted during this procedure. When this procedure is completed, upload the calibration data to the algorithm.
FULL	This button executes the CALFULL procedure. Demodulator gain is adjusted during this procedure. When the procedure is completed, upload the calibration data to the algorithm.
GO TO NULL POINT	This button executes the GO TO NULL POINT procedure. During this procedure, the VP enters local mode and trims target position until position feedback voltage equals 0. Select the **CANCEL** button to exit this mode.
CANCEL	This button exits calibration.
UPLOAD/DOWNLOAD Buttons (Upload and download are **never** executed automatically.)	
UPLOAD	This button copies the data set contained in VP memory to the algorithm record in the workstation.
DOWNLOAD	This button copies the data set contained in the algorithm record to the VP and is written onto the VP's EE memory. Some limit-checking is performed prior to the download.
ENTRY FIELDS Buttons	
FILL	This button fills all the text editing windows with the values in the algorithm record.
CLEAR	This button clears all the values from the text editing windows.
Operator Feedback Fields	
Algorithm Record Name	Information field located on the top right of the graphic.
Voltage	Located below the algorithm name. The voltage shown is the voltage at the output of the programmable gain stage. If the VP is properly calibrated and nulled, the electrical 'stroke' will occupy most of the +-10 volt range of the AD converter input, thus giving good resolution. This field shows activity as the valve is traveling during calibration, and as the demodulator gain is adjusted at the endpoint.

Field	*Description*
Mode (MA)	Located to the left of the Voltage field. VP firmware is designed to stay in ‘normal’ mode, and if it is not in ‘normal’ mode, to establish communications with the Controller and then enter the ‘normal’ mode. In ‘normal’ mode, the VP receives its target position from the Controller. The MA algorithm that drives the VP target position may be in AUTO, MANUAL, or LOCAL mode. When the VP is in ‘normal’ mode, it is not aware of the MA mode. It receives target position from the Controller in MA AUTO and MANUAL. The field will usually show AUTO unless there is an error condition or the VP enters local mode due to a calibration sequence. During calibration, the VP enters local mode, which corresponds to MA local mode. The MA unconditionally tracks the VP until the calibration sequence completes. When the operator selects a calibration sequence, the mode is shown as ‘local’. The voltage will change as the valve is moving. When the valve is at the endpoint and the demodulator gain is adjusting, the voltage will change as the gain is adjusted. A calibration complete message is displayed at the bottom field. In some cases in a full calibration, the results may yield poor values. A message will display telling the operator to repeat the calibration.
Valve Identification	Located to the left of the Mode field. Usually a text string that identifies the valve that is to be calibrated (name is provided by the turbine valve graphic).
Text Messages	Located under the table of values. This field displays messages about the progress of the calibration. For example, “calibration in progress” or “calibration complete.”

28.4.3 PERFORMING REDUNDANT VP CALIBRATION

VPs in a redundant subsystem can be calibrated as a pair or independently. The same commands are used to perform either calibration.

If you want to calibrate the VPs independently, the easiest method is to pull one of the VPs out of the mounting unit. In this case, calibration is the same as for a non-redundant VP. When a VP is calibrated and the Backup is not in service, and the RDNDNT flag is set, a warning message is printed to inform the operator that only one VP of the pair is being calibrated.

In any case, only the Primary VP or a pair can be calibrated. If you attempt to calibrate with the terminal connected to the Backup VP, the VP will print a message stating that the request is refused.

If you request a calibration of the Primary VP, and the Backup VP is also in service, the Backup is calibrated unconditionally. During calibration, the Primary disables the redundancy software state machine so failovers are eliminated.

The message packet exchange between the Primary and Backup VPs includes command/status bits related to calibration. The following table lists those commands and descriptions.

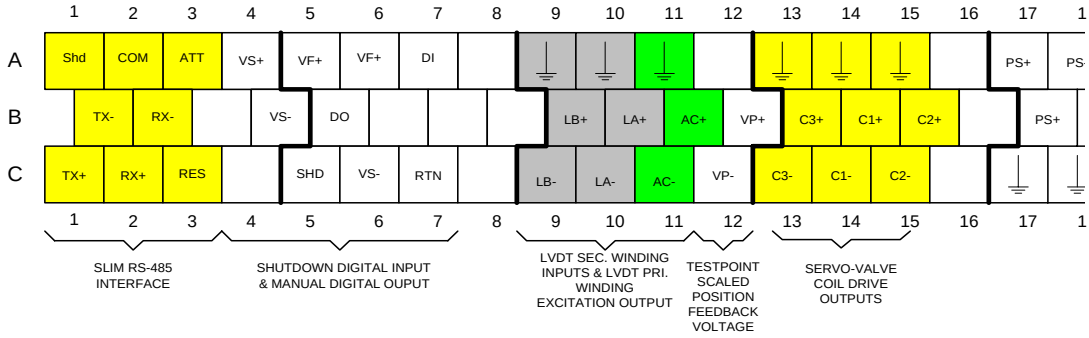
Redundant Calibration Commands

COMMAND	DESCRIPTION
RRVP_CAL_REC_TOP	Primary VP is commanding the Backup VP to record the 100% endpoint value.
RRVP_CAL_REC_BOT	Primary VP is commanding the Backup VP to record the 0% endpoint value.
RRVP_CAL_IN_ PROGRESS	Primary VP is informing the Backup VP that a calibration is in progress.
RRVP_CAL_BACKUP_ HOLD	Backup VP is performing a gain adjustment or is measuring the endpoint and is informing the Primary VP to wait for the process to be completed.
RRVP_CAL_WRITE_EE	Primary VP is commanding the Backup VP to commit the new calibration data to EEPROM memory at the end of the calibration process.
RRVP_CAL_HOT	Primary VP is informing the Backup VP that the calibration process is a “hot” calibration. A “hot” calibration is performed at only one end of the mechanical stroke. The important implication is that demodulator gain adjustment is not allowed during “hot” calibrations.

28.5 WIRING INFORMATION

28.5.1 VALVE POSITIONER TERMINAL BLOCK WIRING INFORMATION

Each Personality module has a simplified wiring diagram label on its side, which appears above the terminal block. This diagram indicates how the wiring from the field is to be connected to the terminal block in the base unit.



Notes

1. If the SLIM communication cable assembly is terminated to the base unit termination block, a wire jumper must be installed between terminal A2 (COM) and A3 (ATT). The SLIM communications cable assembly shield should be connected to terminal A1 (SHD).

2. If the SLIM interface is to have a line receiver parallel termination resistor, a wire jumper must be installed between terminals C2 (RX+) and C3 (RES). This jumper is added if either the base unit termination block or the personality module SLIM female DB9 connector is used to interface the SLIM communications cable assembly.

3. All of the field interface signals must use twisted-pair copper wire conductors inside a shielded cable assembly. The cable assembly shield must be tied to earth ground via one or more of the Earth terminals. For CE Mark systems, the cable assembly shield is not connected to any of the termination block terminals.

4. In CE Mark systems, SLIM cable 5A26429 MUST be used and grounded at the entry point of the cabinet using the recommended hardware (refer to the applicable *Planning Your Ovation System*).

5. C3+ and C3- coil drive outputs are not available for Group 4 Personality modules.

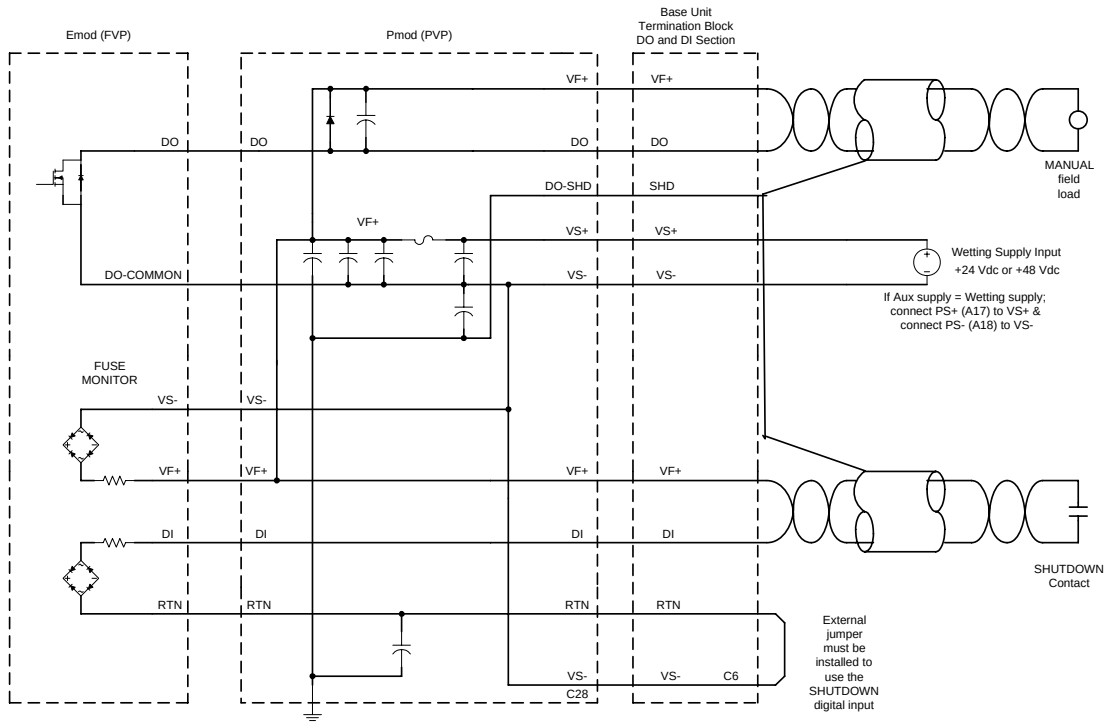
6. Terminals VP+ and VP- are intended to provide a test point voltage that is to be measured by a high input impedance volt meter. If an external device is to be permanently connected to the VP+ and VP- terminals, an interposing buffer is required within the cabinet that houses the VP module. The buffer must have an input impedance greater than 100k ohms and must be able to accommodate an input span of +/- 10 Volts.

Figure 169: Terminal Block Connections for the Valve Positioner Personality Module

ABBREVIATION	DEFINITION
COM	Common terminal of the SLIM interface circuit.
⏚	Earth ground terminals used to connect to input signal's shield (See Valve Positioner Field Connection Wiring Diagram (Non-CE Mark) (see page 462)) (for non-CE Mark systems only).
ATT	SLIM cable attached input, it may have to be connected to COM. See the Figure below .
VS+, VS-	Auxiliary voltage input terminals (+24V or +48V)
VF+	Fused auxiliary voltage source terminal connection
SHD	Shield of digital I/O signals' cable (see Valve Positioner Field Connection Wiring Diagram (Non-CE Mark) (see page 462) for field connection) (for non-CE Mark systems only).
DI	Shutdown digital input.
PS+, PS-	Auxiliary power supply terminals.
TX+, TX-	RS-485 transmit data (output). SLIM interface.
RX+, RX-	RS-485 receive data (input). SLIM interface.
DO	Manual digital output.
LB+, LB-	LVDT secondary winding B input.
LA+, LA-	LVDT secondary winding A input.
AC+, AC-	LVDT primary winding AC excitation output.
VP+, VP-	Demodulated scaled valve position testpoint voltage.
C1+, C1-	Servo valve actuator coil #1 voltage output.
C2+, C2-	Servo valve actuator coil #2 voltage output.
RES	SLIM RS-485 receiver circuit input termination resistor. If receiver termination is desired, RES is connected to RX+.
RTN	Return for digital input. Connect to VS-.
C3+, C3-	Servo valve actuator coil #3 voltages output.

***Note:** Do **not** use unmarked terminal block locations.*

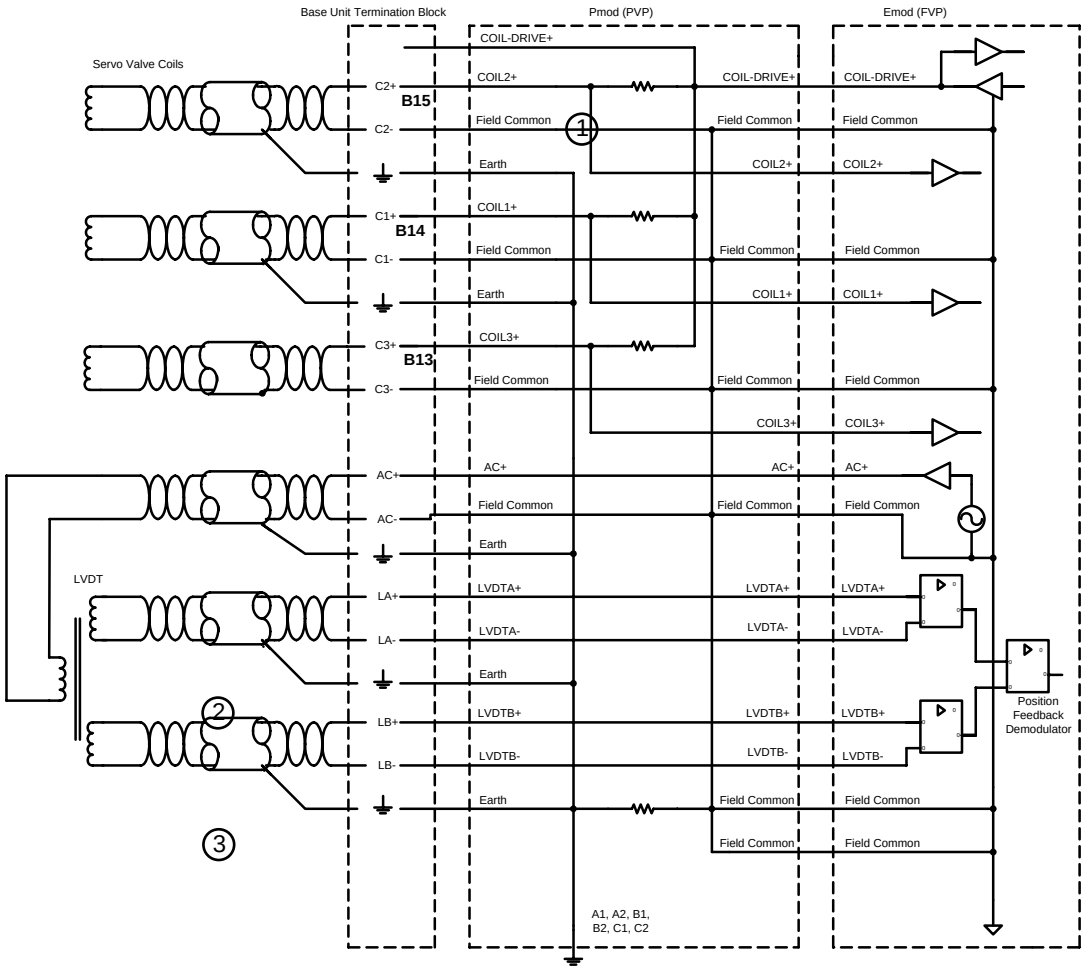
28.5.2 VALVE POSITIONER FIELD CONNECTION WIRING DIAGRAM (NON-CE MARK)



Note

A fault on the MANUAL digital output or on the SHUTDOWN/digital input that causes the personality module fuse to open will disconnect the internal auxiliary supply from both the digital input and the digital output circuit.

Figure 170: Digital Input/Output (internal aux supply) Field Connections (Non-CE Mark)



Notes

1. Negative voltages on terminals B15, B14, and B13 cause the valve to open.
2. The amplitude of this signal decreases as the valve goes open.
3. The amplitude of this signal increases as the valve goes open.

Figure 171: Analog Input/Output Connection (Non-CE Mark)

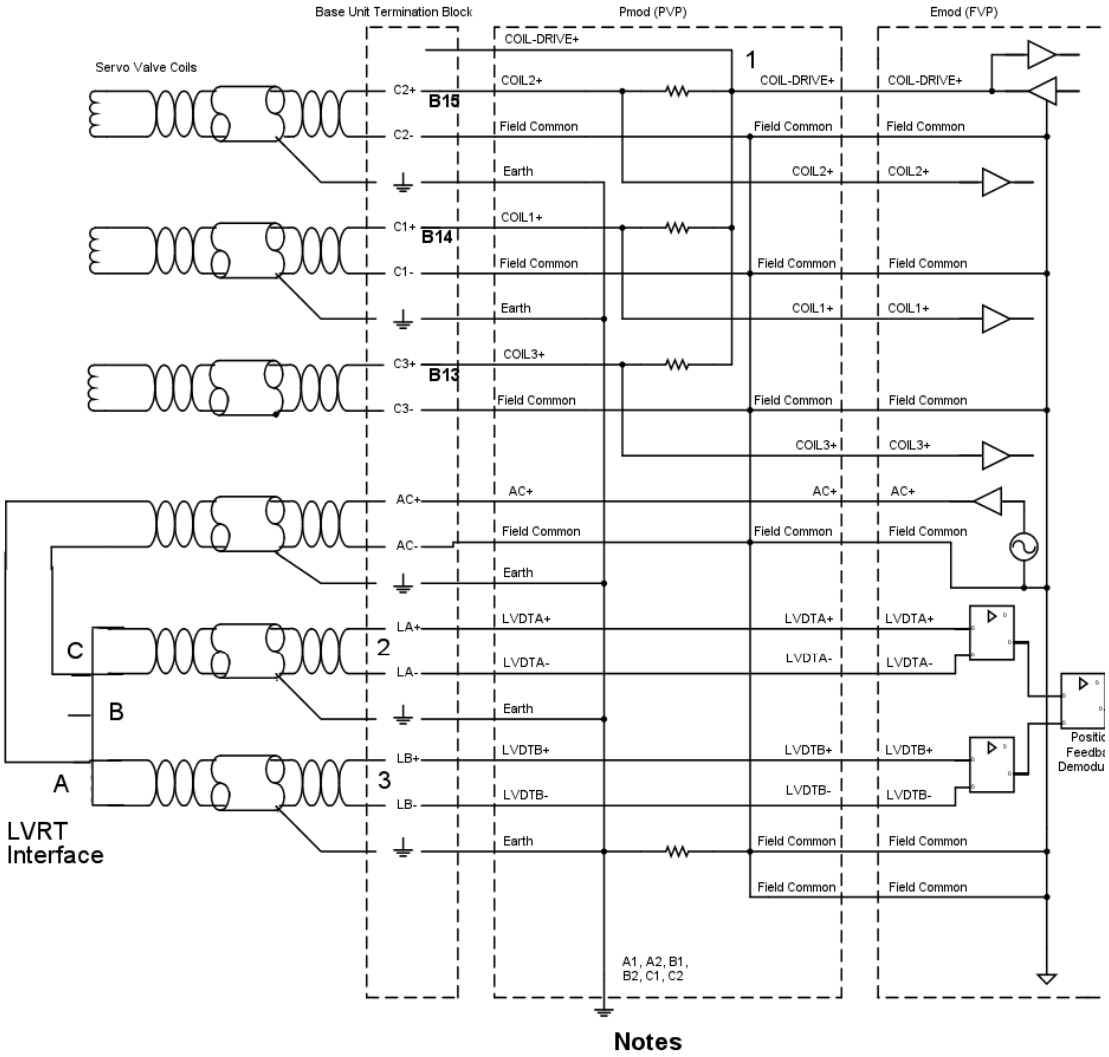
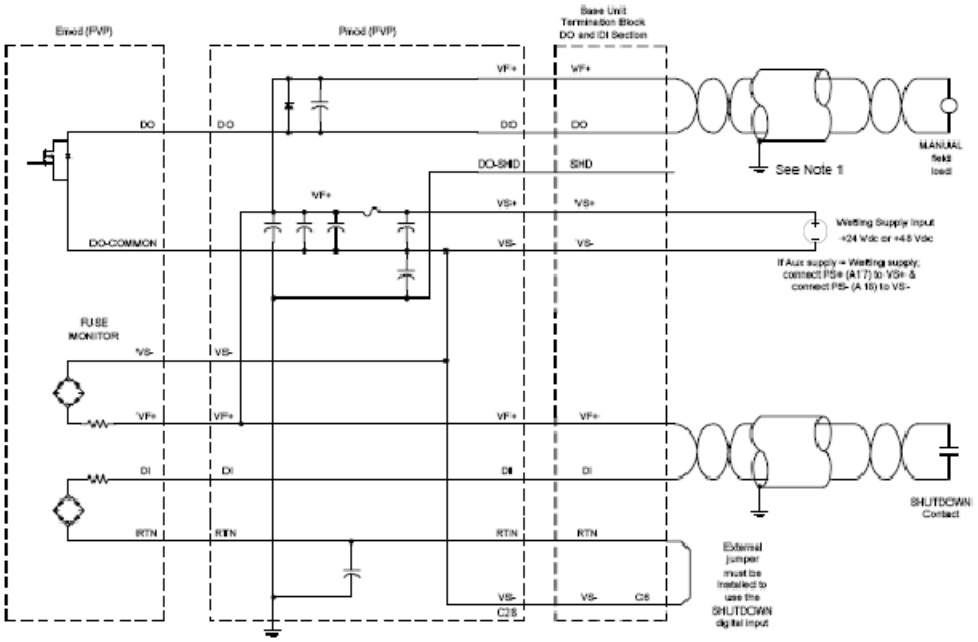


Figure 172: Analog Input/Output Example Using 3-Wire LVRT (Non-CE Mark)

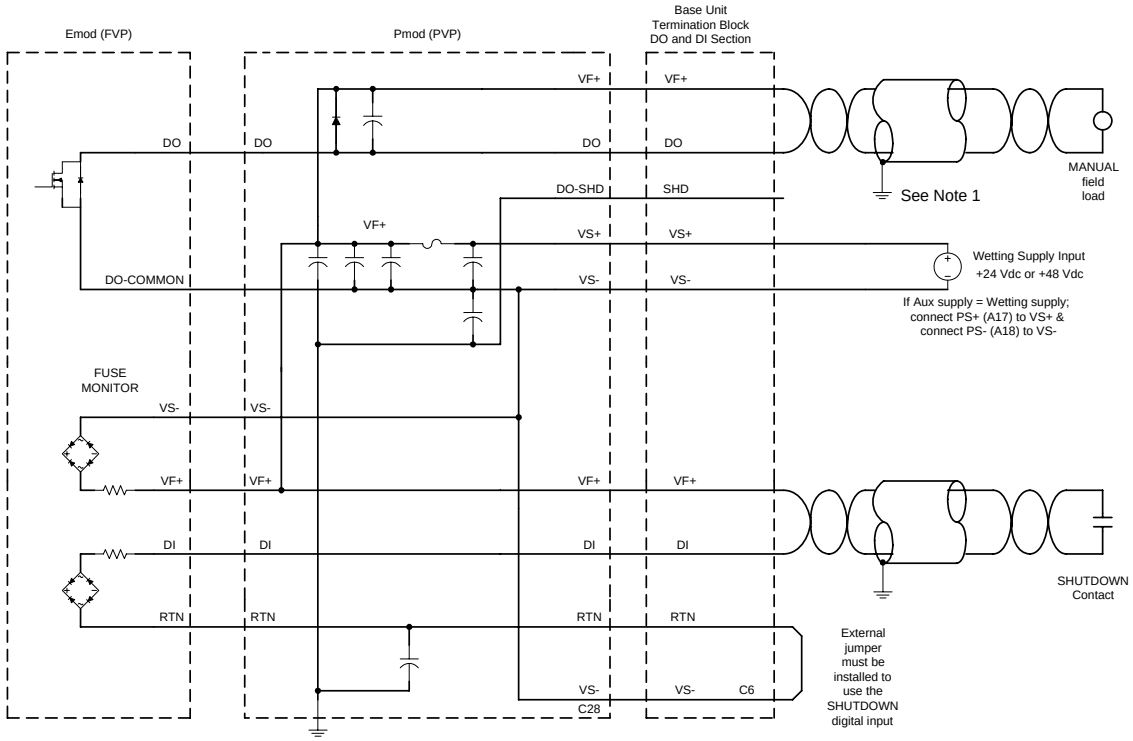


Note

1. All field wiring must be braid-shielded and grounded at the entry point of the cabinet using the recommended hardware (refer to "Cable Guidelines" in the applicable Ovation system installation manual).

Figure 173: Analog Input/Output Example Using One Coil (Non-CE Mark)

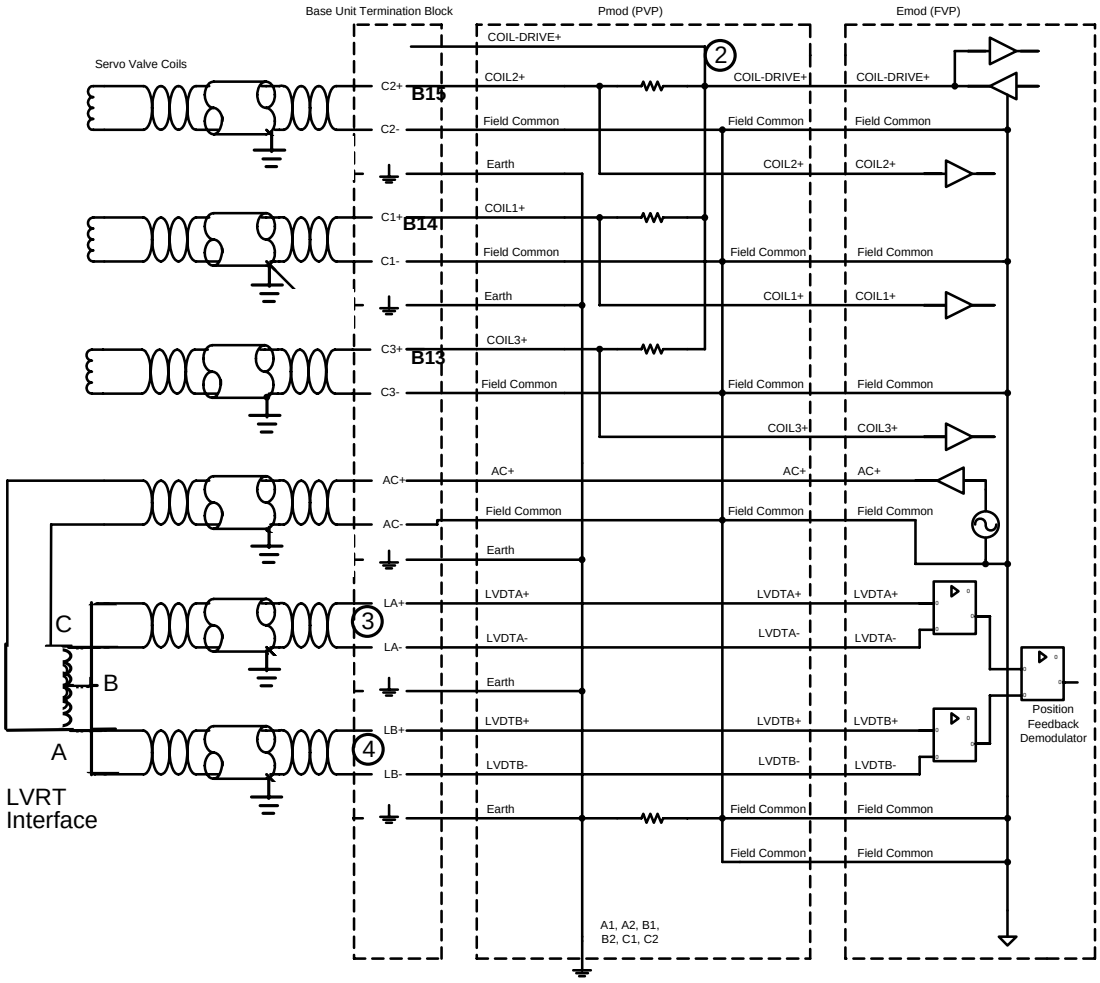
28.5.3 VALVE POSITIONER FIELD CONNECTION WIRING DIAGRAM (CE MARK)



Note

1. All field wiring must be braid-shielded and grounded at the entry point of the cabinet using the recommended hardware (refer to "Cable Guidelines" in the applicable Ovation system installation manual).

Figure 174: Digital Input/Output (internal aux supply) Field Connections (CE Mark)

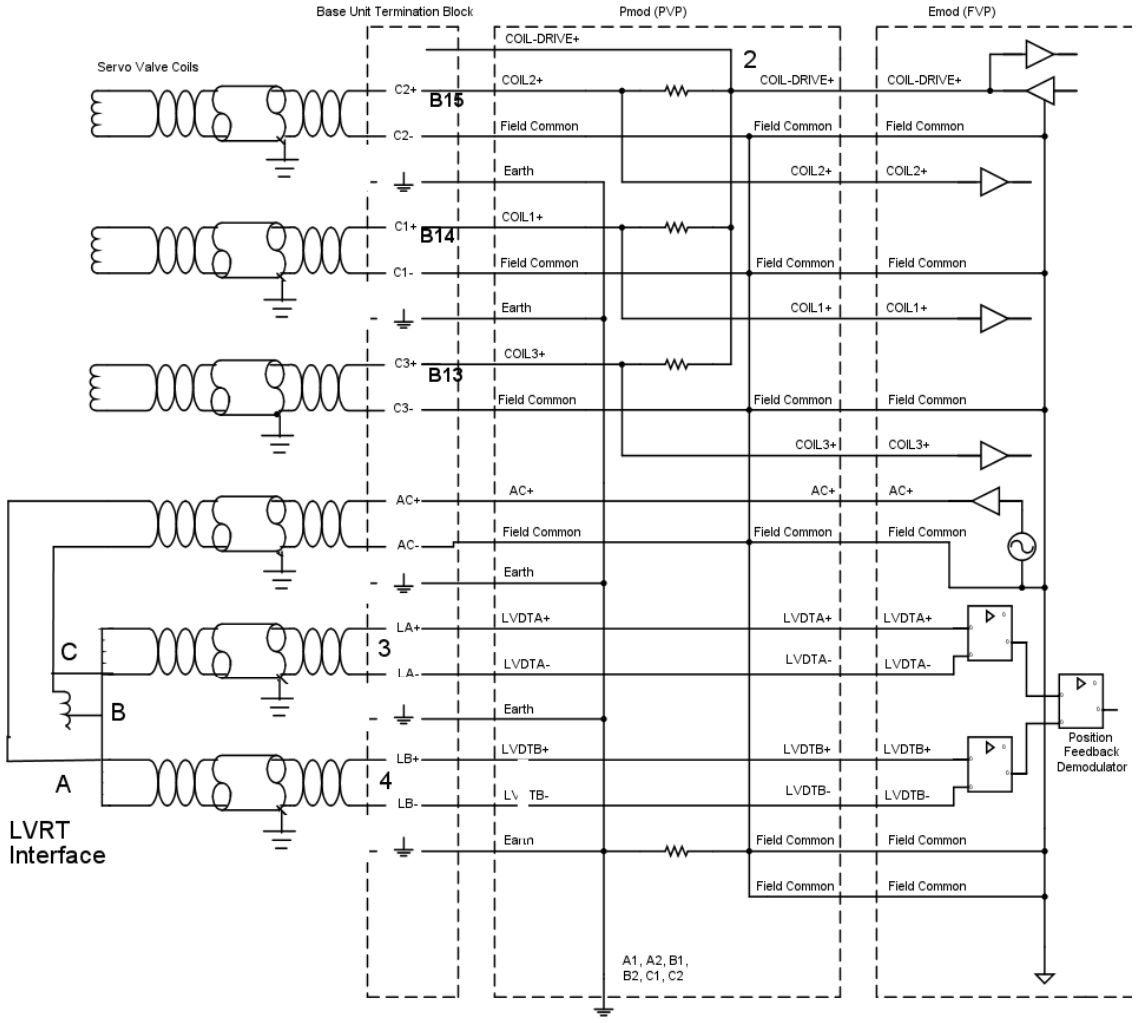


Notes

1. All field wiring must be braid-shielded and grounded at the entry point of the cabinet using the recommended hardware (see "Cable Guidelines" in applicable Ovation installation manual).
2. Negative voltages on terminals B15, B14, and B13 cause the valve to open.
3. The amplitude of this signal decreases as the valve goes open.
4. The amplitude of this signal increases as the valve goes open.
5. Node A is connected to terminals AC+ and LB+,
   Node B is connected to terminals LB- and LA+,
   Node C is connected to terminals AC- and LA-.

Figure 175: Analog Input and Analog Output Connection (CE Mark)

Note: *See Swapping Connections to Affect the Output (see page 469) for phasing options.*



Notes

1. All field wiring must be braid-shielded and grounded at the entry point of the cabinet using the recommended hardware (see "Cable Guidelines" in applicable Ovation installation manual).
2. Negative voltages on terminals B15, B14, and B13 cause the valve to open.
3. The amplitude of this signal decreases as the valve goes open.
4. The amplitude of this signal increases as the valve goes open.
5. Node A is connected to terminals AC+ and LB+,
   Node B is connected to terminals LB- and LA+,
   Node C is connected to terminals AC- and LA-.

Figure 176: Analog Input/Output Example Using 3-Wire LVRT (CE Mark)

28.5.4 SWAPPING CONNECTIONS TO AFFECT THE OUTPUT

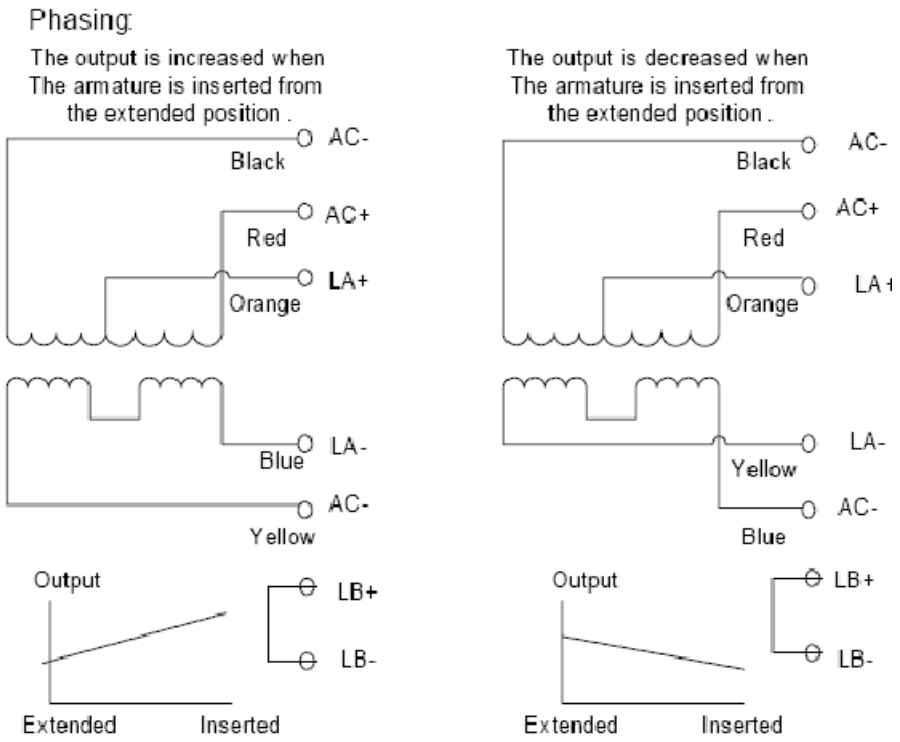


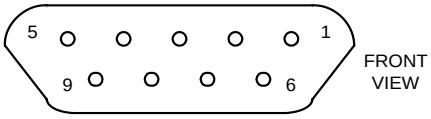
Figure 177: Swapping Connections to Effect the Output

28.6 SLIM SERIAL PORT CONNECTOR

The Personality module SLIM connector is used to connect the Valve Positioner module to a SLIM module (see page 407).

SLIM Connector (J1 RS-485) Pin Assignments

PIN NUMBER	SIGNAL NAME (FUNCTION)	SIGNAL DIRECTION
1	SP-COMMON	NA
2	RX - (Receive Data)	Input
3	Shd (Cable Shield)	NA
4	RX+ (Receive Data)	Input
5	SLIM-ATT/(SLIM Cable Connector Attached) 1	Input
6	TX+ (Transmit Data)	Output
7	No connection	NA
8	TX- (Transmit Data)	Output
9	SP-COMMON	NA

PIN NUMBER	SIGNAL NAME (FUNCTION)	SIGNAL DIRECTION
Front View of J1 Connector (Female DB 9)  **1 The mating connector of the SLIM cable assembly must connect pin 5 to pin 9.**		

28.7 ADDRESS LOCATION INFORMATION

28.7.1 CONFIGURATION AND STATUS REGISTER

Word address 13 (D in Hex) is used to write to the Module Configuration Register and to read the Module Status Register. The status register can be read by using the Point Information window at an Operator Station (see the Bit Pattern Field on the Hardware Tab). Refer to the applicable "*Ovation Operator Station User Guide*" for information about the Point Information window.

Configuration/Status Register (Address 13 or D in Hex)

BIT	DATA DESCRIPTION - CONFIGURATION REGISTER (WRITE)	DATA DESCRIPTION - STATUS REGISTER (READ)
0	Configure Module (1 = configure)	Module is configured (1 = configured; 0 = unconfigured)
1	Force Error (1 = error; 0 = no error)	Internal or Forced Error (1 = error; 0 = no error)
2 - 4	Communications Timeout Setting [1] **Bit 4 Bit 3 Bit 2 = Timeout** 0 0 0 = 16 seconds 0 0 1 = 4 seconds 0 1 0 = 2 seconds 0 1 1 = 1 second 1 0 0 = 500 milliseconds 1 0 1 = 250 milliseconds 1 1 0 = 125 milliseconds 1 1 1 = 62.5 milliseconds	Communications Timeout Setting [1] **Bit 4 Bit 3 Bit 2 = Timeout** 0 0 0 = 16 seconds 0 0 1 = 4 seconds 0 1 0 = 2 seconds 0 1 1 = 1 second 1 0 0 = 500 milliseconds 1 0 1 = 250 milliseconds 1 1 0 = 125 milliseconds 1 1 1 = 62.5 milliseconds
5	Not applicable	Ignore shutdown input (1 = ignore input; 0 = obey input) (This function is only valid when the Controller is running in normal mode. Otherwise, the Valve Positioner obeys the shutdown input.)

6	Redundant RVP Link Status Bit (1=good; 0=bad)	Redundant RVP Link Status Bit (1=good; 0=bad)
7	Not applicable	Severe Fatal Error - Check Register E
8	Not applicable	Coil 1 may be shorted
9	Not applicable	Coil 2 may be shorted
10	Not applicable	Coil 3 may be shorted
11	Not applicable	Coil 1 may be open
12	Not applicable	Coil 2 may be open
13	Not applicable	Coil 3 may be open
14	Not applicable	Contingency (1 = contingency; 0 = no contingency)
15	Not applicable	Handshake bit for download of calibration data
[1] The tolerance on the timeout period is +/- 35%.		

28.7.2 SECONDARY CONFIGURATION AND STATUS REGISTER

Word address 14 (E in Hex) provides for additional module configuration and module status. The bit definitions for this register are encoded as shown in Table.

Secondary Configuration/Status Register (Address 14 or E in Hex)

BIT	DATA DESCRIPTION - CONFIGURATION REGISTER (WRITE)	DATA DESCRIPTION - STATUS REGISTER (READ)
0	Not applicable	EEPROM checksum error
1	Not applicable	PSD 302 EPROM checksum error
2	Not applicable	Shared memory readback error
3	Not applicable	Processor memory readback error
4	Not applicable	FPGA error
5	Not applicable	UART error
6	Not applicable	Processor diagnostic error
7	Not applicable	Coil drive D/A converter output readback error
8	Not applicable	PSD 302 RAM error
9	Not applicable	EEPROM write error
10 - 15	Not used	Not used

28.8 DIAGNOSTICS

One important feature of the servo valve is an adjustable mechanical bias mechanism. This mechanism creates a slight deflection in the valve spool so that a small amount of hydraulic fluid can escape the actuator and close the valve. Therefore, if there is no voltage applied to the servo valve, the actuator will slowly move toward the closed position. This deflection is typically overcome by -200 millivolts, so that when the valve is positioned and steady, this small voltage is seen on the servo valve.

The servo valve has two voltage coils, either of which can deflect the spool when excited. The combination of these features provides a redundancy feature that protects against broken wires or shorted coils, the ability to be diagnosed, and a predictable shutdown mechanism in the event the firmware diagnoses a catastrophic error and executes a shutdown, or an error mode occurs that allows a hardware watchdog timer to expire and de-power the Electronics module's FVP field card.

The Valve Positioner continuously runs diagnostics to ensure that the circuit is operating properly. Certain conditions can cause the Valve Positioner to "dive," essentially removing the output signal and allowing the valve to drift shut.

As a general rule, the card will view error conditions on start up as "no-go" or fatal errors. This means that the Valve Positioner will not generate an output to the valve. See the following error descriptions for specifics.

28.8.1 DA READBACK ERROR

The Valve Positioner has the ability to read and convert the coil drive D/A convertor output signal that drives the valve. If the value readback (converted by the A/D converter) and the value that was output do not match within a deadband, and for a pre-defined period of time, a severe fatal error is assumed. In this case, the Valve Positioner is "flying blind." It cannot confidently determine valve position or control the output. The Valve Positioner will remove drive power (dive) from the entire Electronics module's FVP field card and go through a reset sequence. The coil drive D/A convertor readback check is a diagnostic that runs continuously.

EPROM Checksum Error

The EPROM checksum check runs continuously as a low priority function. Failure of the checksum diagnostic is considered a severe fatal error.

Contingency Check Error

Contingency is defined as the difference between a target position and the actual position, when that difference is greater than a defined limit. In the Valve Positioner, the contingency bit is set if the difference exceeds a programmable limit (default value is 5%) for a programmable time period (default value is 10 seconds). Contingency is not a fatal condition.

Memory Read/Write Check Error

A failure of any memory to read back correctly is considered a severe fatal error.

Open Coil Diagnostic Error

An open coil is detected by measuring voltage across the current limiting resistors on the servo output. When zero volts are detected, either the coil is open, the servo output is at zero, or the mechanical bias on the servo valve has been adjusted to yield that result. When an error condition is detected, an internal “open” bit is set.

For firmware revisions prior to 0F, the diagnostic works as described below. For later revisions, servo coil voltage is measured and compared to a model described by tuning constants “kServo” and “kServoDb.” If the voltage does not fit into the model, due to being too large, “open coil” is blamed and the internal diagnostic bit is set. Then the timing sequence described below is used to post the error bit to the controller.

Typically, the servo coil voltage is -200 mV when the valve is in a stable, controlled position and the servo valve mechanical bias is properly adjusted. If the servo output amplifier voltage amplitude falls below 100 mV, the internal bit is cleared, as though no error condition exists. If servo output voltage is greater than 100 mV, the difference between servo output voltage and coil voltage is compared to 50 mV, and if it is less, the ‘open’ bit is set.

If the open bit stays set for five seconds, the error condition is reported to the Controller in the module status register.

Shorted Coil Diagnostic

For each of the three coil outputs, an internal shorted bit is set if the converted value of terminal voltage is near 0 volts. Behavior of this diagnostic changes when servo output amplifier voltage is near zero.

For firmware revisions prior to 0F, the diagnostic works as described below. For later revisions servo coil voltage is measured and compared to a model described by tuning constants “kServo” and “kServoDb”. If the voltage does not fit into the model, due to being too large, “open coil” is blamed and the internal diagnostic bit is set. Then the timing sequence described below is used to post the error bit to the Controller.

Typically, the servo output coil is -200 mV when the valve is in a stable, controlled position and the servo valve mechanical bias is properly adjusted. If the servo output amplifier voltage falls below 50 mV, the internal bit is cleared, as though no error condition exists.

For servo output voltages greater in amplitude than 400 mV, the module status register voltage is compared to 50 mV, and a shorted bit is set if it is less. If the shorted coil bit remains active for five seconds, the condition is reported to the Controller in status word 1.

For servo amplifier voltage values between 50 and 400 mV, the comparison value is calculated as the servo amplifier voltage divided by eight. The timing described above is used. When the shorted bit becomes inactive, the corresponding bit in status word 1 is cleared immediately.

Diagnostics of LVDT Problems for Redundant VP

Diagnosing an LVDT failure is complex. Depending on the failure, the valve may go open, closed, or to a different intermediated position, which can be above or below the target position. If the valve is positioned at the LVDT null point, an oscillator failure would not be detected because the position feedback would continue to be equal to zero (0) volts.

- If |(Position Feedback - Previous Position Feedback)| < MAXDELTA, and POSITIONERRORFLAG is not set, all conditions are considered normal, and the REDUNDANCY STATE is set to NORMAL. Previous Position Feedback is set equal to Position Feedback prior to exiting the PI routine.
- If (Position Feedback - Previous Position Feedback) > MIN2NDRY and the backup is OK, the VP executes the failover.
- If |(Position Feedback - Previous Position Feedback)| > MAXDELTA, a problem is suspected. VP firmware refuses to “believe” the new position feedback value, and does not update Previous Position Feedback or run the PI loop. If REDUNDANCY STATE is NORMAL, it is updated to POOR. If it is POOR, it is updated to BAD. If it is BAD, and the backup is OK, the VP executes the failover. This means that it can take 30 msec for the VP to determine that it should execute its failover.
- If POSITION ERROR FLAG is set, and the partner’s reported position is within LVDTTRACKING of Position Feedback, the condition is not due to a failed LVDT, but for another reason. No action to fail over is taken.
- If POSITION ERROR FLAG is set, and both Position Feedback voltage and Previous Position Feedback voltage are equal or close to zero volts, the problem is suspected to be a failed oscillator, or broken oscillator wire, and the failover is executed as long as the Backup is OK.
- If POSITION ERROR FLAG is set, and Position Feedback differs from Partner’s Position Feedback by more than LVDTTRACKING, and the Backup is OK, an LVDT problem is suspected and the failover is executed.

28.9 TROUBLESHOOTING

28.9.1 ONLINE VP REPLACEMENT

A Valve Positioner module can be replaced online when the module fails.

Use the following procedure to remove an VP module and safely install a replacement module.

CAUTION! Observe all the precautions and then modify the procedure steps to suit your particular situation.

Precautions

- ☐ If the valve is closed, isolate it hydraulically to prevent any bump when inserting the new VP.
- ☐ Switch the MA driving the VP position to manual, and move the target position to zero. This is done to avoid jostling the valve when the new VP is inserted.
- ☐ For large machines, switch the valves to ‘single’ or ‘full arc’ mode from ‘sequential’ or ‘partial arc’ mode.
- ☐ Keep first stage, or impulse pressure, control loops in service to respond to any upset during the maintenance.

- ☐ If the replacement is due to a suspected or intermittent problem, that can only be corrected by replacement, but the VP is operating, first close the valve by switching the MA to manual, driving the valve to 0%, and then isolate it hydraulically.

To Replace an Online VP

1. Once the valve is closed and in a safe condition, remove the bad VP.
2. Insert the replacement VP into the base unit.
3. Download constants using the Valve Positioner Upload/Download/Calibrate graphic.
4. View the reported feedback position. It should be close to 0%. If it is, the valve can be operated without calibration.
5. View the servo voltage at terminal screws 14B and C, and 13B and C. Note that if the servo voltage has integrated to a few volts negative, and hydraulic fluid is applied suddenly, the valve will 'pop', and the on-board PI will respond and bring the valve back to the target position of 0%. If the target position of 0% is less than 'seatLimit', servo voltage will be positive, thus driving the valve hard to the seat.
6. With the valve closed, you can execute the 0% calibration sequence to find the exact reading for the 0% position. If you believe the 100% calibration is close, the valve can then be operated without calibrating the 100% position, since there is little flow change when the valve is fully opened.
7. Verify that the VP is in the normal operating mode as indicated by the card edge LED.
8. When you determine that it is time to operate the valve, un-isolate the valve hydraulically, drive the target position of the MA to the desired position, and then switch the MA back to 'auto.'

28.9.2 DEMODULATOR GAIN

Demodulator gain directly affects the calibration values at the endpoints. Reducing demodulator gain can be helpful in diagnosing VP problems. Note that the VP must be re-seated, or must be reset, in order to make any new demodulator gain setting effective.

A simple test can be performed to verify correct wiring and polarity.

1. Set 0 and 100% calibration values to –31000 and +31000.
2. Reduce demodulator gain to a low value (2000).
3. Reseat or reset the VP to cause the new demodulator gain to take effect.
4. Set target position to 0%, 100%, then 50% and observe valve movement at all settings.

In this test, you are informing the VP that the electrical valve ‘stroke’ is +/- 10 volts, but you have adjusted demodulator gain so that the actual electrical stroke is much smaller. (Perhaps +/- 1 volt, depending upon the LVDT.) The idea is to force the actual electrical ‘stroke’ to be fully contained within the range of the VP input system.

By setting the target position to 0% or 100%, you can verify correct wiring and polarity. If the valve goes to the correct endpoints, then you should set the target position to 50% as an additional test. The valve should go to the LVDT’s midpoint and hold there.

If the valve does not go to the correct endpoint, then there is a wiring error, and you should first remove one of the servo wire pairs, and repeat the test. The next step would be to swap the wires of the remaining servo wire pair, followed by swapping the wire pairs of LVDT input A with input B.

When the valve moves correctly, verify that the valve operates according to the recommended practice where negative voltage opens the valve, and positive voltage closes it.

During Automatic Calibration

Another problem with demodulator gain can occur during automatic calibration. When the value is backseated and demodulator gain is undergoing an adjustment, it is also predicting the new calibration value at the seated position. If the seated position goes out of range, then the value is cilpped and the user receives a message that a new calibration is necessary.

One of the underlying assumptions of the VP is that, in the worst case, the user positions the LVDT so that the 100% position is at the end of the linear range of the LVDT (possibly non-linear and accurate). Then during calibration, the firmware accepts a value of 100% that is higher in magnitude than the 0% calibration value. If the LVDT is not positioned this way, then you may receive a message that the calibration must be repeated.

If LVDT is not adjusted in this fashion, the user can enter his own demodulator gain, reseat the VP, then perform both the 0% and 100% endpoint calibration. If the results do not yield a calibration value approaching the endpoint, then demodulator gain can be increased, and the process repeated.

28.9.3 LVDT Wiring Problems (6-wire LVDT)

When an LVDT is wired incorrectly, it is typically a case where secondary pair A is swapped with secondary pair B.

The LVDT inputs on the VP are implemented with an amplifier stage that includes diode rectification. Therefore, the two individual wires of a secondary can be swapped and it makes no difference to the VP.

The wires of the excitation oscillator could also be swapped with no effect. The excitation coil and secondary coils are all isolated, so the VP can see only the AC component.

If the secondaries are wired correctly, and the LVDT is in approximately the correct position, feedback voltage shown on the VP calibration graphic is negative when the valve is closed, and positive when the valve is open.

The position feedback voltage is also available on terminals B12 and C12. This signal is used for factory testing and can be used for response testing in the field. It is inverted from the signal shown on the calibration graphic. (One way to avoid confusion is to connect voltmeter GND to B12, and voltmeter input to C12.)

28.9.4 SERVO WIRING PROBLEMS

Valve Wired Backwards

If a servo valve is wired backwards (that is, the wire pair is rolled), the valve will move in the opposite direction. This is a positive feedback situation. The movement of the valve does not cure the position error, it increases it, thus causing the output voltage to move even faster, and drive the valve harder in the wrong direction.

One Pair of Servo Coil Wires, Wired Incorrectly

Another problem is with dual coil servo valves when one pair is wired correctly, and the other is rolled. Thus, the wire pairs are in opposition, and valve movement is indeterminate.

Use the following procedure to correct this problem:

1. Disconnect one of the pairs, since the valve will move with only one pair connected (typically, the first step when diagnosing wiring problems).
2. Calibrate the valve with only one pair of servo wires, since it is the LVDT being calibrated, not the servo valve.
3. After the correct direction of movement is established, reconnect the wires and re-verify correct valve movement and responsiveness.

   For typical dual coil servos adjusted according to the recommendations, the coil voltage is a few hundred millivolts in a steady holding position, 200 mV perhaps. If one coil is disconnected, the valve will remain in a steady position, but the coil voltage will double to 400 mV.

   Once all wiring is connected, the user should observe the movement of the valve, such as during a step change, to determine if PI gain is set properly.

28.10 DIAGNOSTIC LEDS

The following table lists the module's LEDs and describes what they mean when lit.

Valve Positioner Diagnostic LEDs

LED	DESCRIPTION
P (Green)	Power OK LED. Lit when the +5V power is OK.
C (Green)	Communications OK LED. Lit when the Controller is communicating with the module. In a Redundant configuration, C is lit if both the Controller and Serial Communication are OK. It blinks if only one is OK. It is NOT lit if both are not OK.
E (Red)	External Fault LED. Possible causes: SLIM not connected (Set "SlimAddr=0" to disable) No auxiliary voltage (Set "ignore shutdown" config bit to disable)

LED	DESCRIPTION
I (Red)	Internal Fault LED. Possible causes: Force Error bit (Bit 1) of the Configuration Register (see page 470) is set. Also lit when a timeout of the watchdog timer occurs when Controller stops communicating with module. Any of the hardware errors listed in Secondary Status Register (see page 471).
1 - MANUAL (Green)	Lit whenever the module is operating in Local Manual mode.
2 - SERVO OK (Green)	Lit to indicate the servo coil diagnostic has passed. The coil 1, 2, and 3 open/short bits that are reported to the Controller are delayed by a timer. The timer value is set by “diagtime=xx.” The LED is extinguished immediately for any of the six coil problems.
3 - NORMAL (Green)	Lit whenever the module is operating in Normal mode. Blinks if it is the Primary in a redundant configuration.
4 - PI DETUNE (Green)	Lit whenever PI is detuned.
5 - CALIBRATE (Green)	Lit whenever the module is calibrating.
6 - BACKSEAT (Green)	Lit whenever seating or backseating is in effect.
7 - CONTINGCY (Red)	Lit whenever the module is operating in contingency condition.
8 - SHUTDOWN (Red)	Lit when the module is driving the valve fully closed due to the module shutdown digital input.

28.11 SPECIFICATIONS

Electronics Module (1C31194)

Personality Module (1C31197)

Valve Positioner Module Specifications

DESCRIPTION	VALUE
Valve positioning field interface channels	One
LVDT position feedback Input range	25 V AC peak to peak (LVDT A and LVDT B) maximum
LVDT position feedback input impedance	20 kW (LVDT A and LVDT B) differential input with floating source 10 kW (LVDT A and LVDT B) one input line referenced to common

DESCRIPTION	VALUE
LVDT excitation output voltage	17 V AC peak to peak ± 11% @ 1.0 kHz ± 10% (1C31194G01) 23.75 V AC peak to peak ± 11% @ 3.0 kHz ± 10% (1C31194G02) 500 W minimum load impedance (1C31194G01 & G02) Drift 0.5% max/yr
Peak servo valve coil output voltages	(1C31197G01) up to three 82 W coils, ±2.04 V (1C31197G02) up to three 250 W coils, ±4.20 V (1C31197G03) up to three 1000 W coils, ±8.26 V (1C31197G04) up to two 125 W coils, ±4.5 V
Servo valve coil output voltage accuracy	0.4% of full scale output
Field interface dielectric isolation	±1000 V DC The valve positioning field interface has 50 V and 150 V short term isolation from the logic common/Ovation I/O bus
SLIM interface serial port	RS-485
SLIM interface serial port baud rate	9600
SLIM interface dielectric isolation	±1000 V DC
Local serial port	RS-232, non-isolated
Local serial port baud rate	19200
SHUTDOWN digital input Input voltage range Propagation delay of contact change of state Cable length Dielectric isolation	 24 V/48 V DC nominal, 18 V DC minimum, 60 V DC maximum 1.9 mSec minimum; 25.5 mSec maximum 1000 feet maximum (cable capacitance £ 50 pF/ft) ±1000 V DC
MANUAL digital output Output voltage Off voltage (maximum) On voltage (maximum) Output current Off current (maximum) On current Maximum propagation time Dielectric isolation	 60 V DC 1.0 V @ 500 mA 0.2 V @ 100 mA 25 mA @ 60 V, TA = 25× C 250 mA @ 60 V, TA = 60× C 500 mA 2.5 mSec for Rload = 500 W ±1000 V DC

DESCRIPTION	VALUE
Module power	Main: 4.3 2W typical, 6.5 W maximum Aux: **Digital Input:** 0.09 W (24V) typical 0.18 W (48V) typical **Digital Output** (100mA load) 2.4 W (24V) typical 4.8 W (48V) typical
Logic board processor	80C196KB (16-bit microcontroller)
Operating temperature range	0 to 60°C (32°F to 140°F)
Storage temperature range	-40°C to 85°C (-40°F to 185°F)
Humidity (non-condensing)	0 to 95%

SECTION 29

OVATION LOCAL I/O

IN THIS SECTION

Description *481*
Local I/O Features *482*
Controller Cabinet Components (Local I/O) *482*
Extended I/O Cabinet Components *486*
Cabinet Components (Controller and Extended Cabinet) *488*
General Requirements for I/O Cable *491*
Local I/O Status LEDs *491*

29.1 DESCRIPTION

Note: *Ovation local I/O is applicable for use in CE Mark certified systems except where noted.*

The Ovation Distributed Control System provides modulating control, sequential control, and data acquisition for a variety of system applications. The local Ovation I/O consists of a mix of functional I/O units (modules) that communicate on the I/O bus to the Controller in the Controller's cabinet or in close proximity (9.1 meters (30 ft)).

Ovation I/O (see page 482) also provides for remote I/O functions.

Typically, the Ovation local I/O subsystem contains:

- Controller cabinet with the redundant Ovation Controller, applicable I/O Interface Controller (see page 482) (IOIC) cards (PCQL or PCRL) power supplies, and I/O modules,
- Extended I/O cabinet with additional I/O modules and power supplies (see page 486).
- Appropriate cable and connections (see page 491) between the cabinets (See *Planning and Designing Your Ovation System*.)
- Interface support of existing Q-Line I/O using a PCQL card.

Note: *Optional Ovation Marshalling cabinet configurations are also available, which provide for halfshell wiring terminations. (See* Planning and Designing Your Ovation System*.)*

29.2 LOCAL I/O FEATURES

The Ovation local I/O subsystem has the following features:

- Maximum number of local I/O modules per PCRL: 64 (eight branches with eight modules each).
- Maximum number of Local I/O modules per Controller: **128** (two PCRLs)
- Modular, “plug-in” components.
- Quick installation and configuration of the modules.
- DIN Rail mounting of the I/O base units.
- Unique base unit interconnection scheme eliminates power and communications wiring.
- Base unit common to all standard I/O modules and base units are available for Relay Output modules.

29.3 CONTROLLER CABINET COMPONENTS (LOCAL I/O)

The Ovation I/O Controller cabinet (see page 484) contains the following:

Note: *Refer to the appropriate* Planning and Installing Your Ovation System *manual for your system for additional cabinet and cable information.*

- Redundant Ovation Controller Chassis (see page 485) - Housing two separate Controllers. Each Controller contains:
  - ☐ Pentium PC Processor Board - To perform I/O control.
  - ☐ Power Supply Board - Converts +24V to +5V and ±12V to power all components of the Controller chassis.
  - ☐ Network Interface Card - Provides the interface between the Ovation Controller and other highway components of the system, FDDI/CDDI and Fast Ethernet versions are supported.
  - ☐ PCRL Board - **PCI** to local Ovation I/O interface board, used only if controlling local I/O modules (up to two PCRL cards per each Controller).
  - ☐ PCQL Board - **PCI** to local Q-Line interface board, used only if controlling local Q-Line I/O boards (up to two PCQL cards per each Controller). **(Not applicable for CE Mark certified systems.)** Refer to the appropriate *Q-Line Installation Manual* for your system for Q-Line I/O installation information.

- Power Supply - DIN Rail Mounted. Generates +24V to power the electronics in the I/O Controller Cabinet, as well as +24V auxiliary power. Two are required for redundancy. An optional separate +48V auxiliary power supply is also available.
- Power Distribution Module (see page 486) (5A26304) - Provides connectors for cables used to distribute +24V to the Redundant Controller Chassis, and +24V and auxiliary power to branches of local I/O.
- Standard I/O Modules and Bases (see page 488) - Standard Ovation I/O modules which interface to field devices.
- Relay Output Module and Bases (see page 491) - Relay module base, 1.5 times larger than a standard I/O base unit, containing electronics module and relays to control field devices (see page 491).
- I/O Dual Branch Transition Panel (see page 491) (ROP - 4D33922) - Connects to two branches of I/O, providing a point to bring in +24V redundant power, auxiliary power, and the local I/O communications bus.

  Connections are provided on the I/O Transition Panel to daisy-chain the local I/O communications bus from one ROP to the next (up to eight I/O branches **maximum** may be daisy-chained together).
- I/O Branch Terminator **(1B30023)** - Connects to the A or B-side of a standard I/O base at the end of a branch having no Attachment Unit Module to terminate the local I/O bus.

CAUTION! The I/O addressing for the Ovation database is determined from the positions of the bases installed in the cabinets.

We recommends that all possible bases (typically four) be installed in the right-most branch of each side of a cabinet, even if they are not all filled with I/O modules. This will prevent disruption of the database if additional I/O modules are installed in the future.

I/O modules should be installed in the right-most branch of each side of a cabinet from the BOTTOM UP. I/O modules should be installed in the left-most branch of each side of a cabinet from the TOP DOWN.

If Relay Output modules are mixed with Standard I/O modules on the same branch, the Standard I/O module base must always start in an odd-numbered position on the branch (positions 1/2, 3/4, 5/6, or 7/8).

29.3.1 CONTROLLER CABINET COMPONENTS AND CABLING (LOCAL I/O)

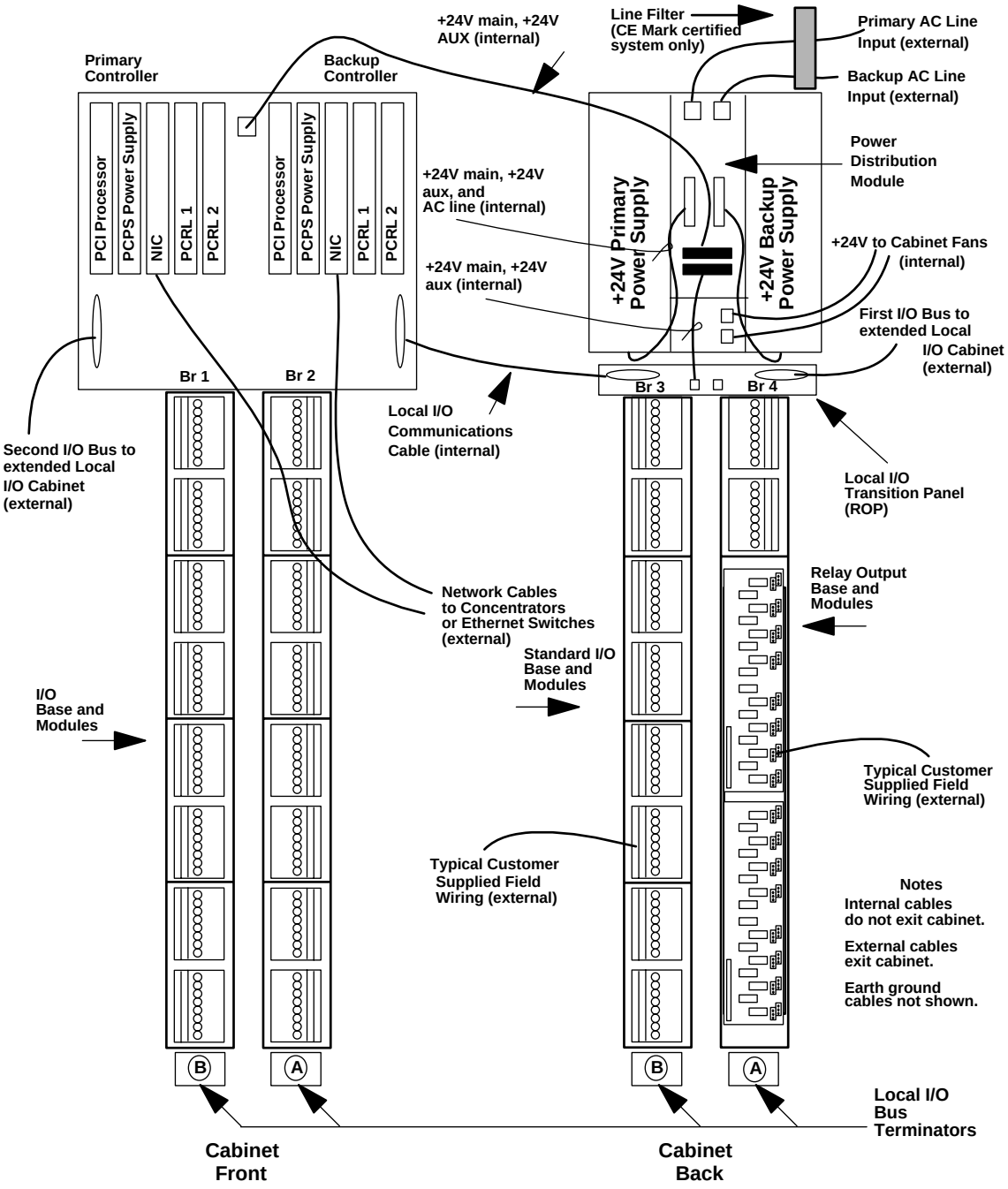


Figure 178: Controller Cabinet Components and Cabling (local I/O)

29.3.2 CONTROLLER BACKPLANE (CBO)

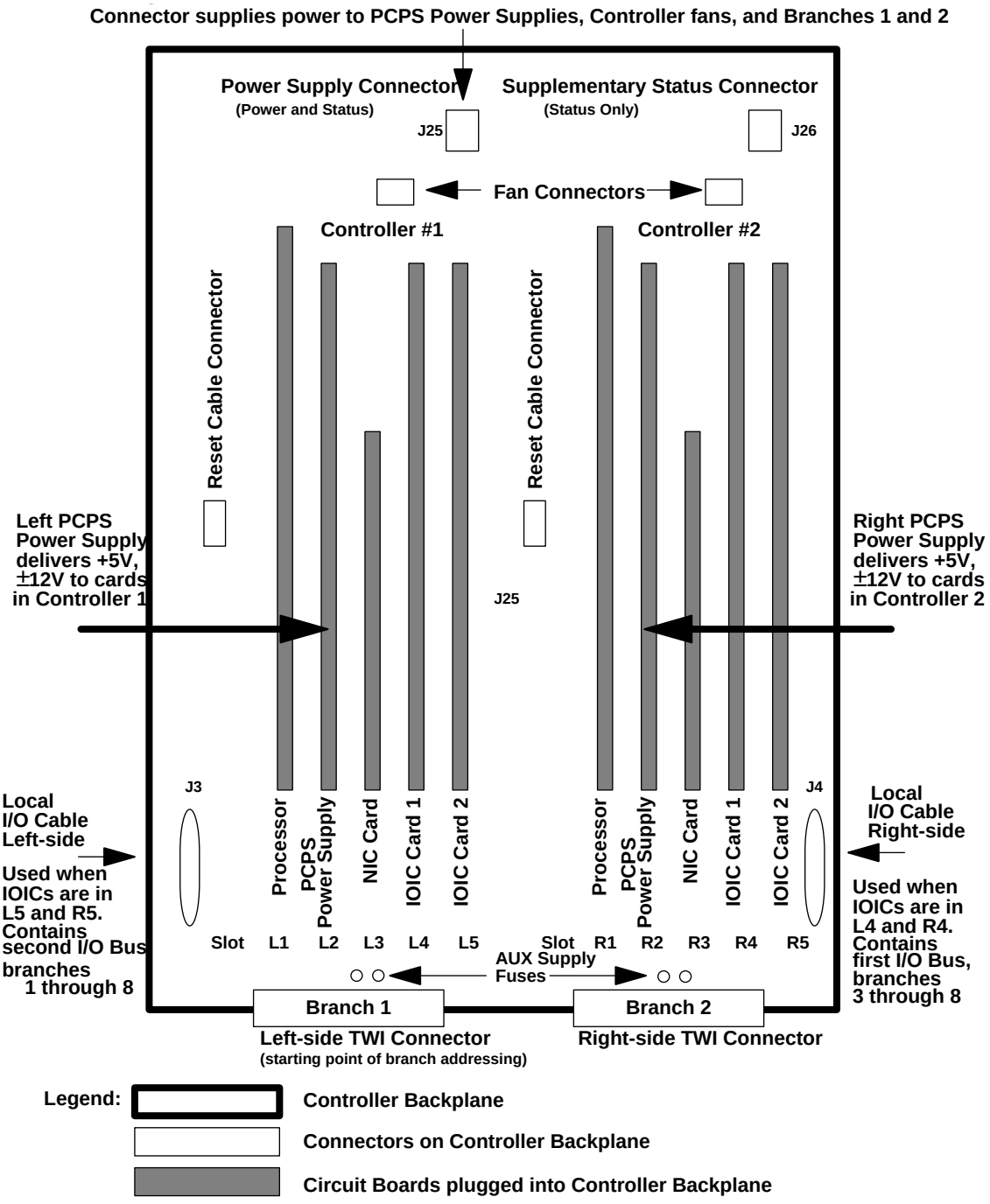

Connector supplies power to PCPS Power Supplies, Controller fans, and Branches 1 and 2
Power Supply Connector
(Power and Status)
J25
Supplementary Status Connector
(Status Only)
J26
Fan Connectors
Controller #1
Controller #2
Reset Cable Connector
Reset Cable Connector
Left PCPS Power Supply delivers +5V, ±12V to cards in Controller 1
Right PCPS Power Supply delivers +5V, ±12V to cards in Controller 2
J25
J3
J4
Local I/O Cable Left-side
Used when IOICs are in L5 and R5. Contains second I/O Bus branches 1 through 8
Local I/O Cable Right-side
Used when IOICs are in L4 and R4. Contains first I/O Bus, branches 3 through 8
Processor
PCPS Power Supply
NIC Card
IOIC Card 1
IOIC Card 2
Slot L1 L2 L3 L4 L5
Slot R1 R2 R3 R4 R5
AUX Supply Fuses
Branch 1
Branch 2
Left-side TWI Connector
(starting point of branch addressing)
Right-side TWI Connector
Legend:
Controller Backplane
Connectors on Controller Backplane
Circuit Boards plugged into Controller Backplane

Figure 179: Controller Backplane (CBO)

29.4 Extended I/O Cabinet Components

The Ovation I/O Extended cabinet contains the following:

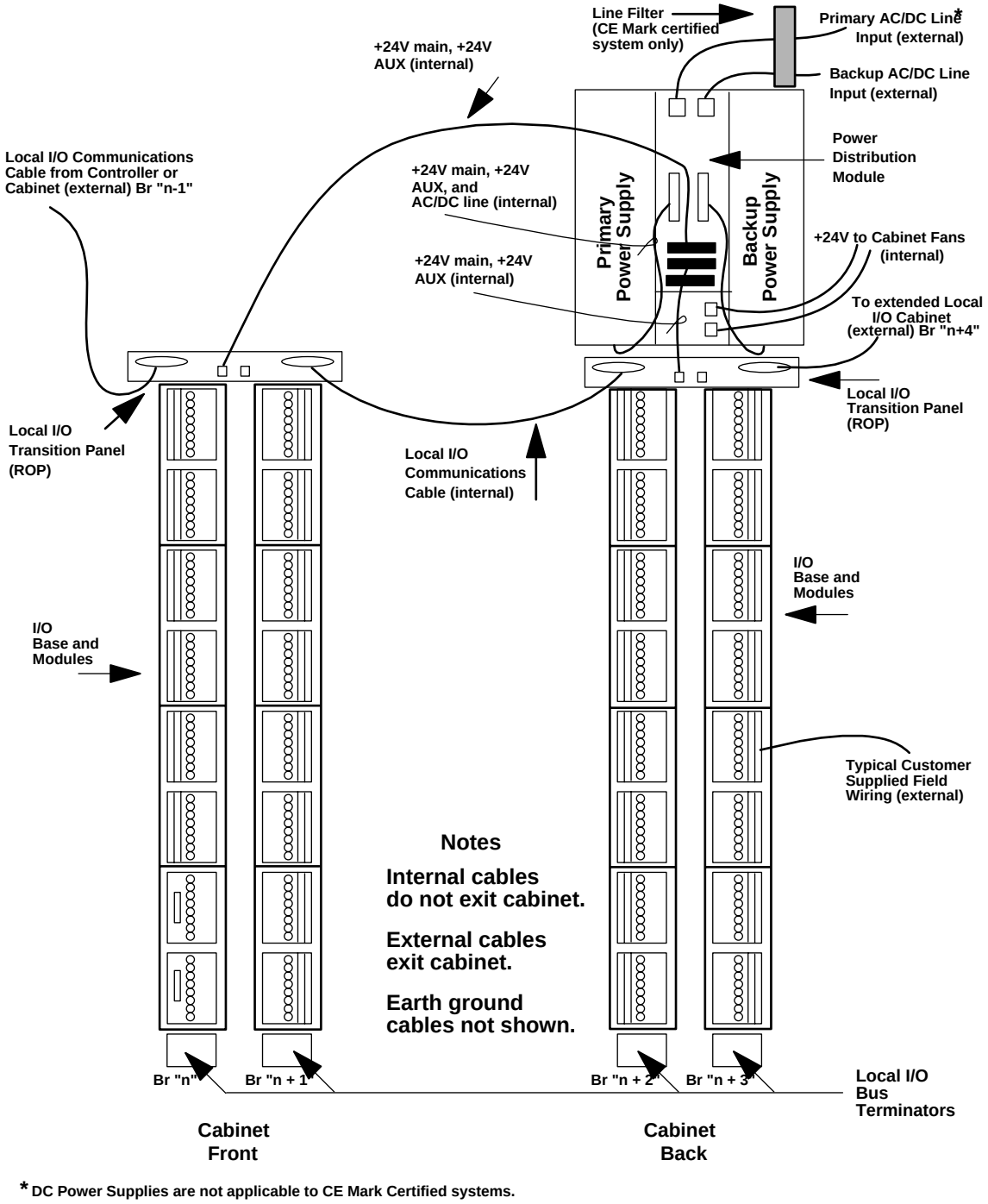
Refer to the Planning and Installing Your Ovation System *manual that is appropriate for your system for additional cabinet and cable information.*

- Power Supply - DIN Rail Mounted. Generates +24V and auxiliary power for the local I/O modules in the extended cabinet. Two are required for redundancy.
- Power Distribution Module **(5A26304)** - Provides connectors for cables used to distribute power to branches of local I/O.
- Standard I/O Modules and Base - Standard Ovation I/O modules which interface to field devices.
- Relay Output Module and Bases - Relay module base, 1.5 times larger than a standard I/O base unit, containing electronics module and relays to control field devices.
- I/O Dual Branch Transition Panel (ROP - 4D33922) - Connects to two branches of I/O, providing a point to bring in +24V redundant power, auxiliary supplies, and the local I/O communications bus.

  Connections are provided on the I/O Transition Panel to daisy-chain the local I/O communications bus from one ROP to the next (up to eight I/O branches **maximum** may be daisy-chained together).

- I/O Single Branch Transition Panels
  (Top - RRP 3A99252; Bottom - RRB 3A99253) - Used with Relay Output modules for a single I/O branch of up to eight relay bases.

  Supplies +24V redundant power, auxiliary power, and local communications bus to the branch. Mounted at the top/bottom of the extended cabinet. Only **ONE** I/O branch is used and remaining branches are passed on.



* DC Power Supplies are not applicable to CE Mark Certified systems.

Figure 180: Ovation Extended I/O Cabinet (illustrating cables and Standard I/O)

29.5 CABINET COMPONENTS (CONTROLLER AND EXTENDED CABINET)

The following figures illustrate components that may be contained in both Controller cabinets and extended cabinets:

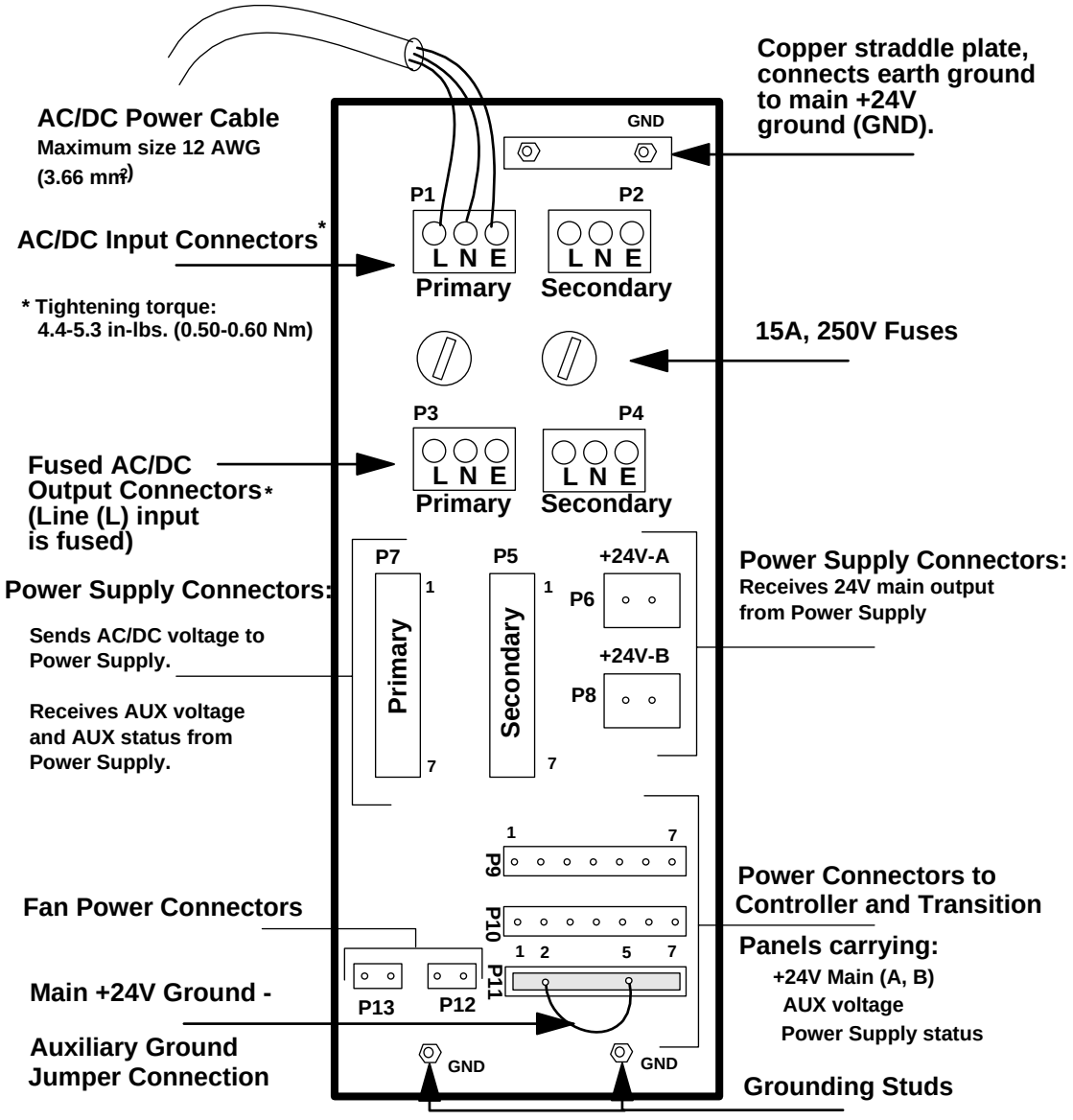


Figure 181: Ovation Power Distribution Module (PDM)

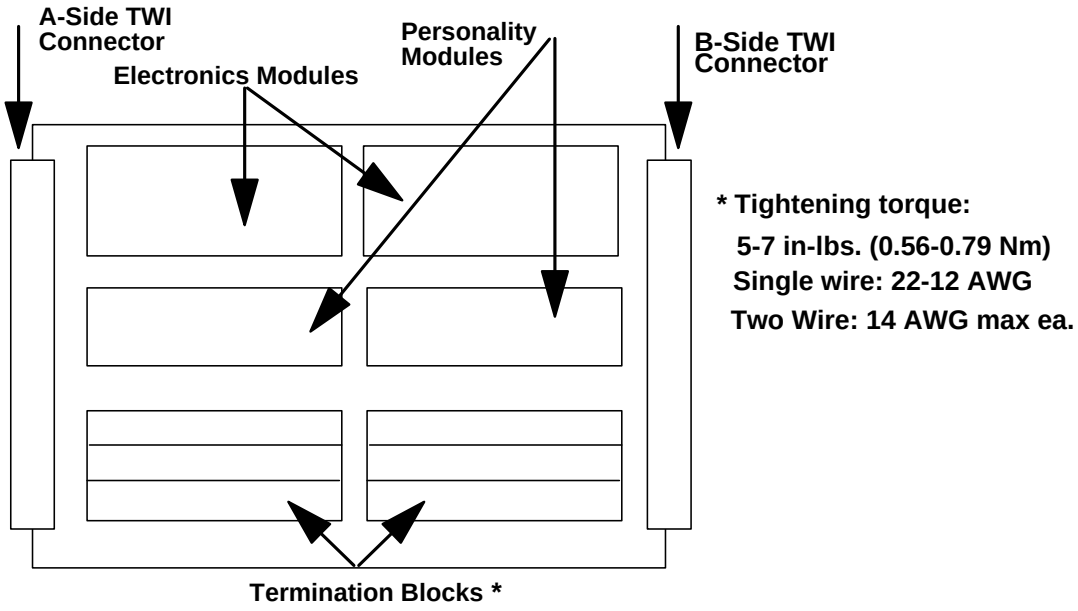


Figure 182: Ovation Standard I/O Modules and Base Units

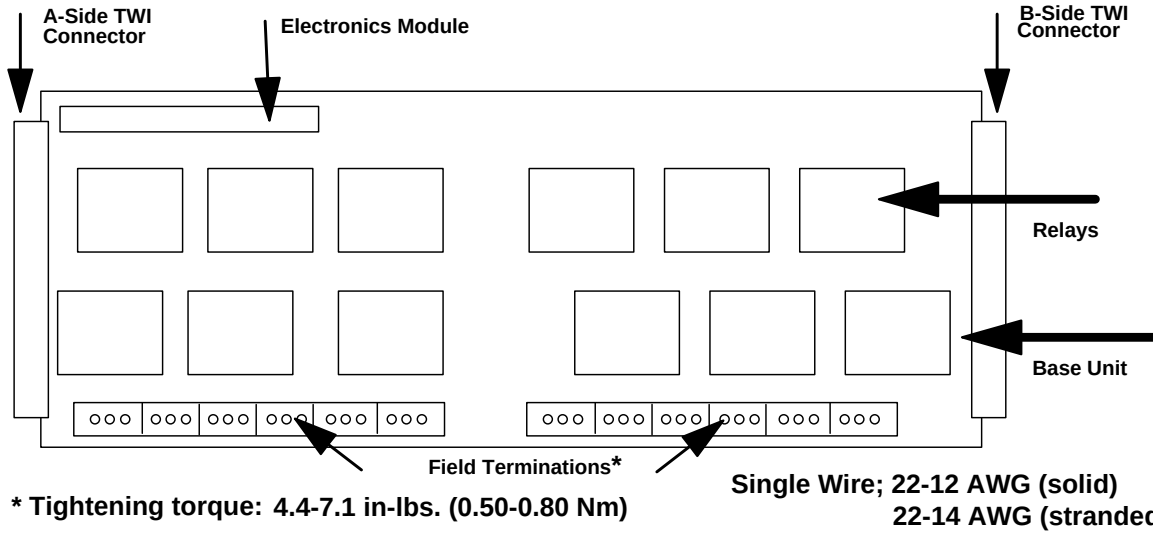
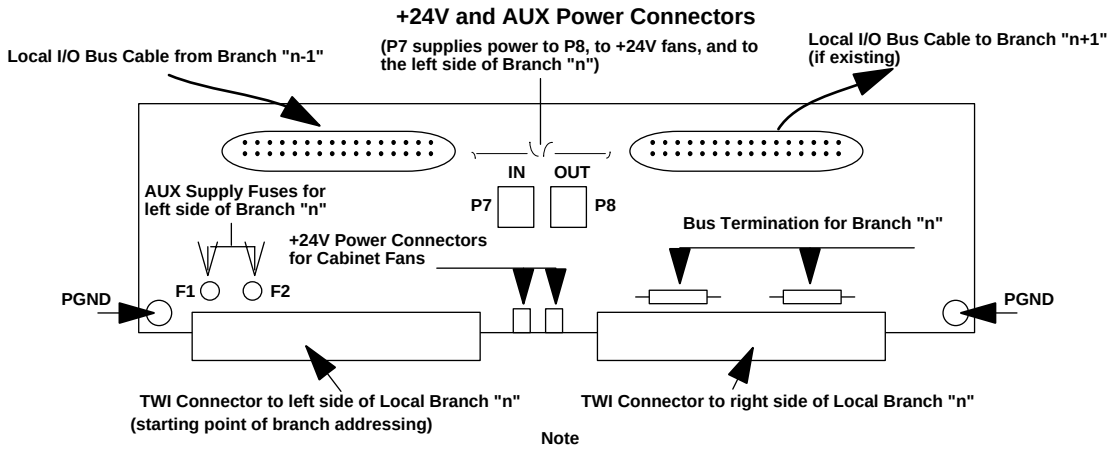


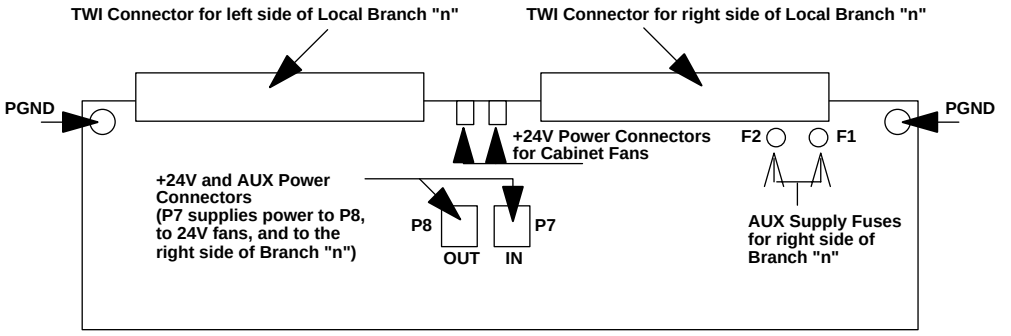
Figure 183: Relay Output Module (12 KUEP Style Relays)


+24V and AUX Power Connectors
Local I/O Bus Cable from Branch "n-1"
(P7 supplies power to P8, to +24V fans, and to the left side of Branch "n")
Local I/O Bus Cable to Branch "n+1" (if existing)
IN
OUT
AUX Supply Fuses for left side of Branch "n"
P7
P8
Bus Termination for Branch "n"
+24V Power Connectors for Cabinet Fans
F1
F2
PGND
PGND
TWI Connector to left side of Local Branch "n" (starting point of branch addressing)
TWI Connector to right side of Local Branch "n"

Note

The RRP is typically used in conjunction with the RRB.

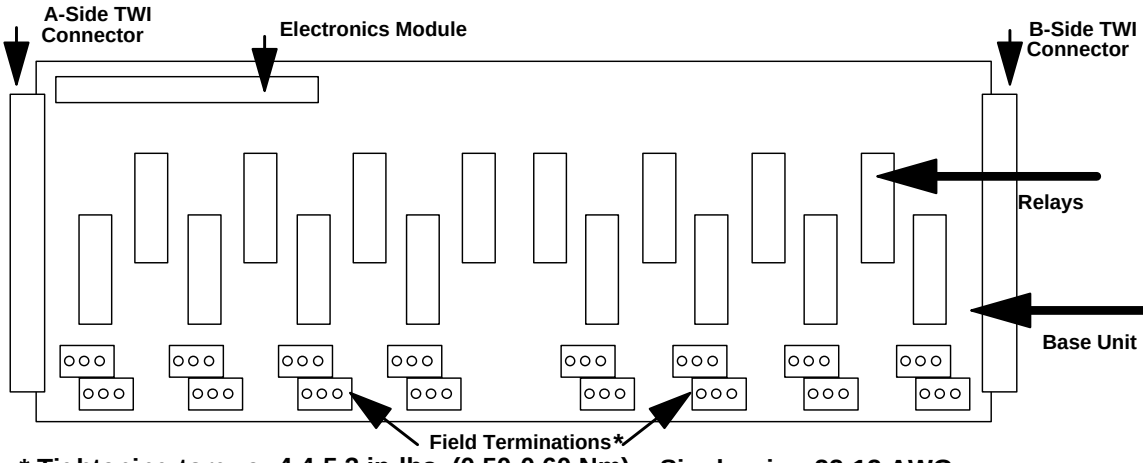
Transition Panel (RRP at top of branch)


TWI Connector for left side of Local Branch "n"
TWI Connector for right side of Local Branch "n"
PGND
PGND
+24V Power Connectors for Cabinet Fans
F2
F1
+24V and AUX Power Connectors (P7 supplies power to P8, to 24V fans, and to the right side of Branch "n")
P8
P7
OUT
IN
AUX Supply Fuses for right side of Branch "n"

Notes

1. **The RRP is typically used in conjunction with the RRB.**
2. **I/O module addresses continue from the left side TWI connector to the right side TWI connector.**

Transition Panel (RRB at bottom of branch)



*** Tightening torque: 4.4-5.3 in-lbs. (0.50-0.60 Nm)** **Single wire: 22-12 AWG**

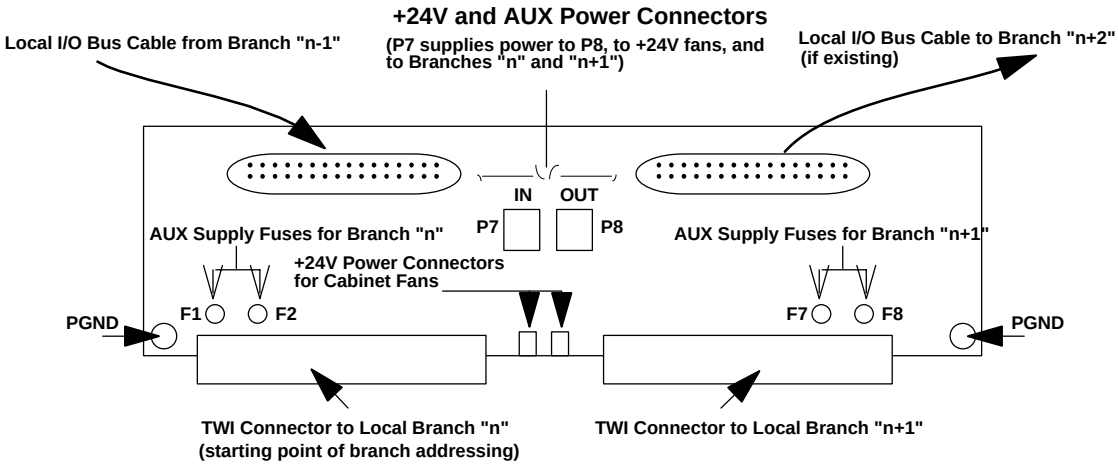

+24V and AUX Power Connectors
(P7 supplies power to P8, to +24V fans, and to Branches "n" and "n+1")
Local I/O Bus Cable from Branch "n-1"
Local I/O Bus Cable to Branch "n+2" (if existing)
IN
OUT
P7
P8
AUX Supply Fuses for Branch "n"
AUX Supply Fuses for Branch "n+1"
+24V Power Connectors for Cabinet Fans
F1
F2
F7
F8
PGND
PGND
TWI Connector to Local Branch "n" (starting point of branch addressing)
TWI Connector to Local Branch "n+1"

Figure 184: Ovation I/O Dual Branch Transition Panel (ROP)

29.6 General Requirements for I/O Cable

29.6.1 Local I/O Communications Cable (5A26141)

This cable allows you to expand local I/O to additional branches by daisy-chaining connections between either the Controller backplane or Remote Node Controller Transition panel and additional local I/O Transition panels.

Total Length: 9.1 meters maximum (30 ft).

29.6.2 Selecting the IOIC (PCI) Cards

There are two slots available for I/O interface cards for each functional processor in the redundant Controller cabinet (see page 482). The following IOIC cards must be used:

- Use a **PCRL** card for local Ovation I/O.

  Up to eight branches of Ovation modules can be supported by one PCRL. Use a second PCRL in the Controller if more branches are used.

- Use a **PCQL** card for local Q-Line I/O.

  One PCQL card will support one DIOB. Use a second PCQL card in the Controller if a second DIOB is used.

29.7 Local I/O Status LEDs

Two Controller modules used in the Ovation local I/O subsystem are equipped with LEDs that provide diagnostic displays. These modules are the PCQL (see page 492) and the PCRL (see page 492) .

29.7.1 LEDs for PCQL Card

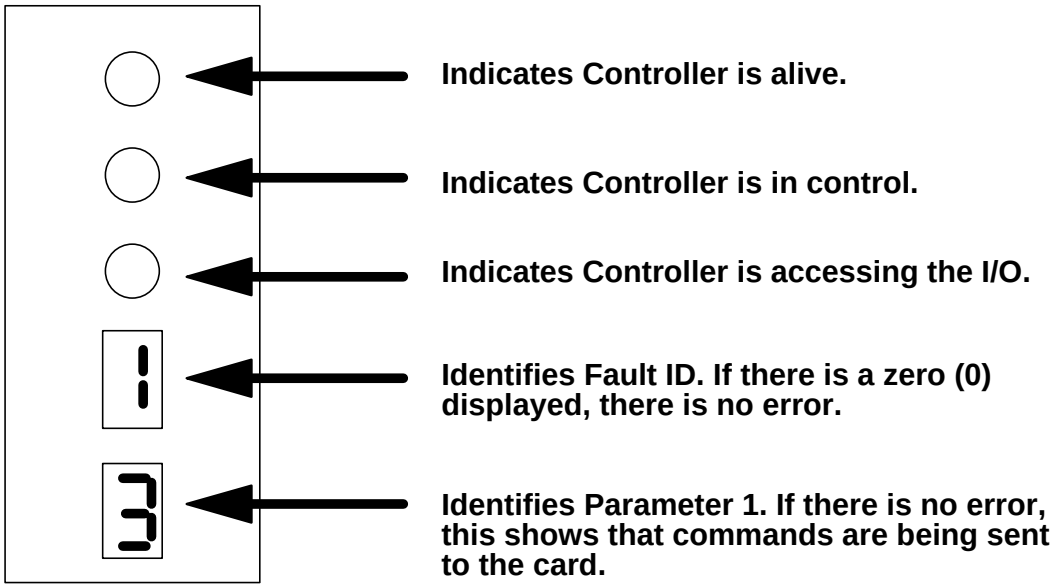

Indicates Controller is alive.
Indicates Controller is in control.
Indicates Controller is accessing the I/O.
Identifies Fault ID. If there is a zero (0) displayed, there is no error.
Identifies Parameter 1. If there is no error, this shows that commands are being sent to the card.

Figure 185: PCQL Card used with Q-Line I/O

Observe the following LED indicators for the PCQL card:

- ☐ **POWER** and **ALIVE** are lit when the Controller is on.
- ☐ **CTL** is lit when the Controller is in control.
- ☐ **ACT** is lit when the Controller is accessing the I/O database.
- ☐ The Hexadecimal displays will display status and error codes (See *Ovation Error Codes and Messages*.) Currently, they cycle through the hexadecimal characters.

29.7.2 LEDs for PCRL Card

Observe the following LED indicators for the PCRL card:

- ☐ **POWER** is lit when the Controller is on.
- ☐ The eight lights indicate the status of the I/O branches.

- ☐ The Hexadecimal displays will display status and error codes (See *Ovation Error Codes and Messages*).

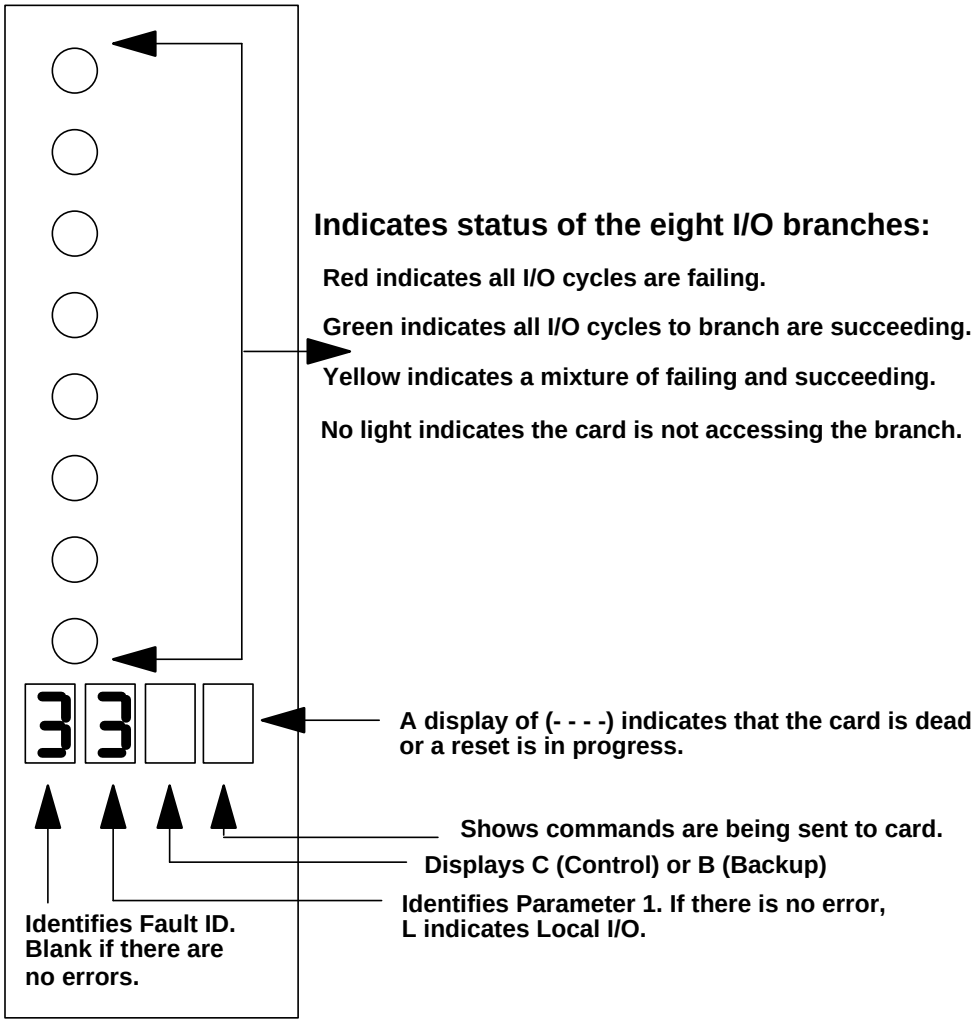

Indicates status of the eight I/O branches:
Red indicates all I/O cycles are failing.
Green indicates all I/O cycles to branch are succeeding.
Yellow indicates a mixture of failing and succeeding.
No light indicates the card is not accessing the branch.
A display of (- - - -) indicates that the card is dead or a reset is in progress.
Shows commands are being sent to card.
Displays C (Control) or B (Backup)
Identifies Parameter 1. If there is no error, L indicates Local I/O.
Identifies Fault ID. Blank if there are no errors.

Figure 186: PCRL Card used with Ovation Local I/O

SECTION 30

OVATION REMOTE I/O

IN THIS SECTION

Description *495*
Remote I/O Features *496*
Controller Cabinet Components (Remote I/O) *496*
Remote Node Cabinet Components *503*
Extended I/O Cabinet Components *507*
General Requirements for I/O Cable *513*
Configuring Remote I/O Cabinets *514*
Diagnostic LEDs *518*

30.1 DESCRIPTION

Note: *Ovation remote I/O is applicable for use in CE Mark certified systems except where noted.*

The Ovation Distributed Control System provides modulating control, sequential control, and data acquisition for a variety of system applications. Although using local I/O (see page 481) is typically the most practical control solution, a remote process might need to be controlled.

Remote I/O is typically used where a process requires that I/O modules be located near the process, even though the Controller is not. The remote I/O modules are connected to the Controller through long distance, serial media, such as fiber-optic cables.

Typically, the Ovation remote I/O subsystem contains:

- Controller cabinet (see page 496) containing the redundant Ovation Controller, applicable I/O Interface Controller (IOIC) cards (PCRR), power supplies, and I/O modules.
- Remote Node cabinet(s) (see page 503) containing the redundant Remote Node Controller module, as well as I/O cards.
- Extended I/O cabinet (see page 507) containing additional I/O modules and power supplies.
- Appropriate cable (see page 513) and connections between cabinets (See *Planning and Designing Your Ovation System*.)

Note: *An optional Ovation Marshalling cabinet is also available. The rear of this 32 inch wide cabinet provides for halfshell wiring terminations, but has the same mechanical and electrical performance as the standard Ovation cabinet. (See* Planning and Designing Your Ovation System*.)*

30.2 REMOTE I/O FEATURES

The Ovation remote I/O subsystem has the following features:

- Maximum number of Remote Nodes: **16 nodes**, redundantly controlled (eight nodes for each PCRR card).
- Maximum number of I/O modules per remote node: **64**[1] (eight branches with eight modules for each branch).
- Maximum number of I/O modules per PCRR card: **512**[1] (eight nodes, eight branches for each node, eight modules for each branch).
- Maximum number of I/O modules per Controller: **1024**[1].
- Remote I/O Bus configuration: 10 BASE-FL Ethernet physical layer with a proprietary protocol.
- Remote I/O cycle time: <**100**m **sec** (typical), double byte word access as seen by PCRR.
- Standard Remote communications media offered: **Fiber-optic**
- Maximum cable length (see page 496) for 850 nm fiber-optic media: **2 km (**without repeaters**)**[2].
- Maximum cable length (see page 496) for 1300 nm fiber-optic media: **4 km**.
- Distances of **6 km** can be achieved with repeaters (up to two repeaters) (Not applicable for CE Mark certified systems.).[2]
- Remote communication diagnostics can be performed in the Primary and Backup system without affecting I/O modules. The diagnostics available are:

  1. Simulation of all types of bus cycles (such as local I/O including statuses, bit corruption, message length faults, collision faults, and no response).
  2. Loopback of all messages from PCRR through the MAU.
  3. Connection check of AUI cable and remote node link.

- Status LEDs: Available on PCRR, MAU, and RNC modules.
- Interface support of existing Q-Line I/O using Q-Line QOR card.

[1] These numbers represent hardware capabilities. Controller software limitations are not implied.

[2] Repeaters are third-party Ethernet devices that must be endorsed by Emerson design engineers.

30.3 CONTROLLER CABINET COMPONENTS (REMOTE I/O)

The Ovation Remote I/O Controller cabinet (see page 499) contains the following:

- Redundant Controller Chassis (see page 500) - This rack in the Controller cabinet provides the backplane for two separate Controllers. For each Controller, the backplane interconnects the following components:
  - ☐ Pentium PC Processor Board - Third party functional processor for the Controller.
  - ☐ Power Supply Board Kit - Contains a PCPS power supply converting +24V to +5V and ±12V to power all components in the Controller chassis.

- ☐ Network Interface Card (NIC) - Provides the interface between the Ovation Controller, and the other highway components of the system. FDDI/CDDI and Fast Ethernet versions are supported.
- ☐ PCRR Board - **IOIC** (**PCI)** to remote Ovation or Q-Line I/O interface board, serving as the master of the remote I/O bus. Refer to the "*Q-Line Installation Manual*" for remote Q-Line I/O installation information (only 850 nm optics, with 2 km maximum length, are available for remote Q-Line applications).

  A PCRR board has two Attachment Unit Interface (AUI) ports each of which may connect to an Attachment Unit Module using an AUI cable. Together, the two ports typically serve as the primary I/O bus master with another PCRR card providing the redundant pair (up to two PCRR cards per each Controller).

- Power Supply - DIN Rail Mounted. Generates +24V to power the electronics in the I/O Controller Cabinet, as well as +24V auxiliary power. Two are required for redundancy. An optional separate +48V auxiliary power supply is also available.
- Power Distribution Module **(see page 509) (5A26304)** - Provides connectors for cables used to distribute +24V to the Redundant Controller Chassis, and +24V and auxiliary power to branches of local I/O.
- Standard I/O Modules and Bases (see page 510) - Standard Ovation I/O modules which interface to field devices.
- Relay Output Module and Bases (see page 511) - Relay module base, 1.5 times larger than a standard I/O base unit, containing electronics module and relays to control field devices).
- I/O Dual Branch Transition Panel (see page 512) (ROP - 4D33922) - Connects to two branches of I/O, providing a point to bring in +24V redundant power, auxiliary power, and the local I/O communications bus.

  Connections are provided on the I/O Transition Panel to daisy-chain the local I/O communications bus from one ROP to the next (up to eight I/O branches **maximum** may be daisy-chained together).

- I/O Branch Terminator (see page 513) **(1B30023)** - Connects to the A or B-side of a standard I/O base at the end of a branch having no Attachment Unit Module to terminate the local I/O bus.

CAUTION! The I/O addressing for the Ovation database is determined from the positions of the bases installed in the cabinets.

We recommends that all possible bases (typically four) be installed in the right-most branch of each side of a cabinet, even if they are not all filled with I/O modules. This will prevent disruption of the database if additional I/O modules are installed in the future.

I/O modules should be installed in the right-most branch of each side of a cabinet from the BOTTOM UP. I/O modules should be installed in the left-most branch of each side of a cabinet from the TOP DOWN.

If Relay Output modules are mixed with Standard I/O modules on the same branch, the Standard I/O module base must always start in an odd-numbered position on the branch (positions 1/2, 3/4, 5/6, or 7/8).

- Media Attachment Unit (see page 501) (**MAU**) - This module provides a point of attachment for fiber optic cables used to transfer messages over long distances between the PCRR and up to four remote nodes (see page 502). The module directs messages between the PCRR and one of the four remote nodes at a time as selected, converting signals readable by the PCRR to signals compatible with the fiber optic media and vise versa. The following components comprise the MAU:
  - ☐ Electronics Module (1C31179) - Houses the Attachment Unit Logic Board (LAU) which provides power for the module and displays LED indication that the fiber optic cables are connected and the Remote Node Controller Module has power.
  - ☐ Personality Module (1C31181) - Houses the Attachment Unit Personality Board (PAU) which translates signals between the PCRR and the fiber optic media and provides connectors for the fiber optic cables.

MAU Subsystem

ELECTRONIC MODULE	PERSONALITY MODULE	LENGTH OF OPTICAL LINK [1]	CHANNELS	OPTICS [2]
1C31179G01	1C31181G01	Up to 2 kilometers (6,560 ft)	2	850 nm
1C31179G02	1C31181G02	Up to 2 kilometers (6,560 ft)	4	850 nm
1C31179G01	1C31181G03	Up to 4 kilometers (13,120 ft)	2	1300 nm
1C31179G02	1C31181G04	Up to 4 kilometers (13,120 ft)	4	1300 nm

[1] In order not to be required to select extended PCRR time-out periods, it is recommended that you do NOT exceed an optical length of 3.7 km.

[2] An Ovation Controller cabinet MAU MUST use the same type of optics (850 nm or 1300 nm) for each of the remote nodes that it interfaces. An MAU cannot interface both 850 nm remote nodes (using 1C1204G01 Personality modules) and 1300 nm remote nodes (using 1C31204G03 Personality modules.)

- ☐ Media Attachment Unit Base **(1C31206)** - This base holds a maximum of two modules and provides a connector for the AUI Cable which interconnects the PCRR and Attachment Unit Module. The backplane routes +24V to the Attachment Unit Modules for power. It also provides local I/O bus termination.

Therefore, I/O branch terminator boards are not required at the end of branches where Media Attachment Unit modules are placed.

30.3.1 CONTROLLER CABINET COMPONENTS AND CABLING (LOCAL AND REMOTE I/O)

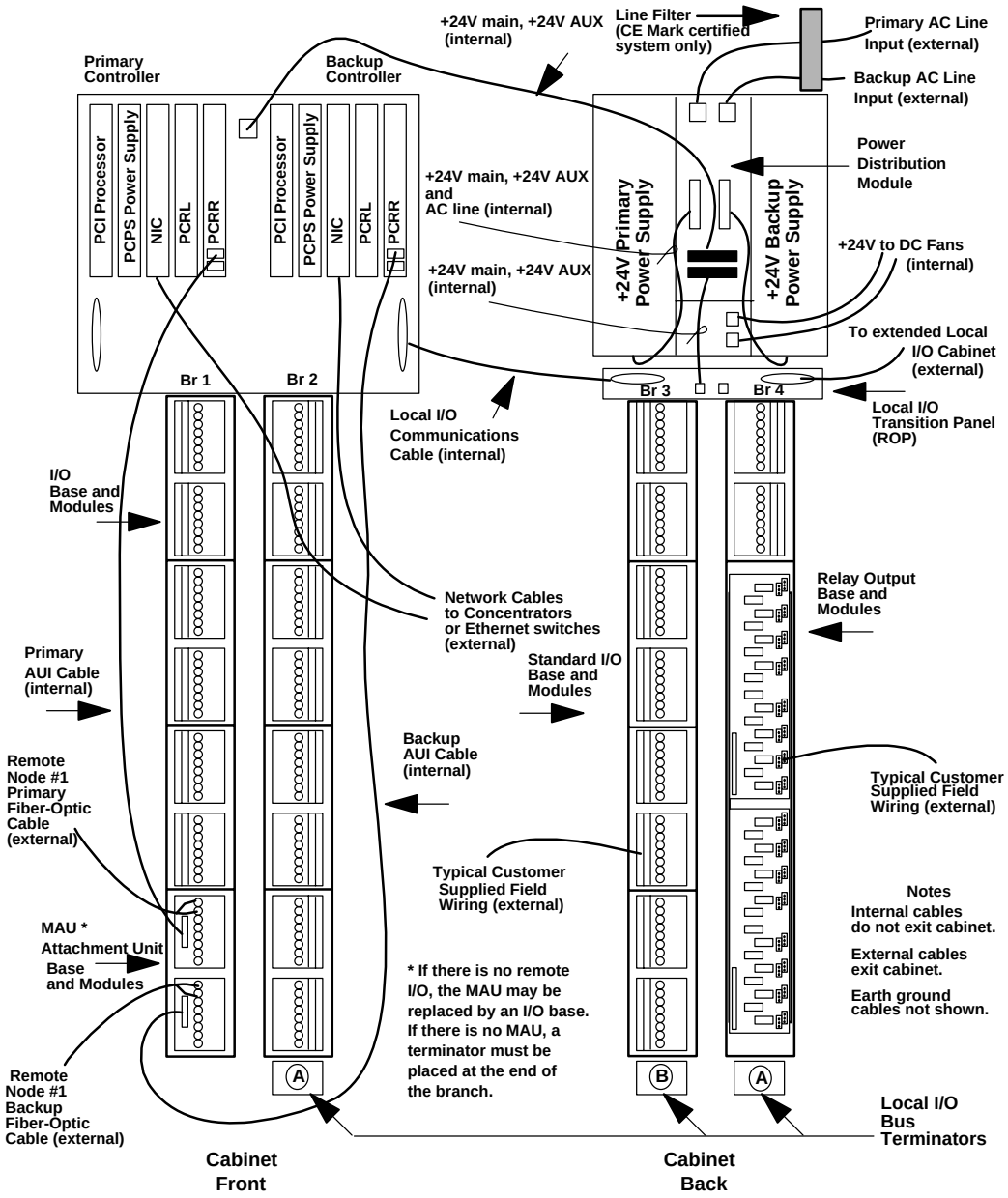

+24V main, +24V AUX (internal)
Line Filter (CE Mark certified system only)
Primary AC Line Input (external)
Backup AC Line Input (external)
Primary Controller
Backup Controller
PCI Processor
PCPS Power Supply
NIC
PCRL
PCRR
Power Distribution Module
+24V main, +24V AUX and AC line (internal)
+24V Primary Power Supply
+24V Backup Power Supply
+24V to DC Fans (internal)
+24V main, +24V AUX (internal)
To extended Local I/O Cabinet (external)
Br 1
Br 2
Br 3
Br 4
Local I/O Communications Cable (internal)
Local I/O Transition Panel (ROP)
I/O Base and Modules
Network Cables to Concentrators or Ethernet switches (external)
Relay Output Base and Modules
Primary AUI Cable (internal)
Standard I/O Base and Modules
Backup AUI Cable (internal)
Remote Node #1 Primary Fiber-Optic Cable (external)
Typical Customer Supplied Field Wiring (external)
Typical Customer Supplied Field Wiring (external)
Notes
Internal cables do not exit cabinet.
External cables exit cabinet.
Earth ground cables not shown.
MAU * Attachment Unit Base and Modules
* If there is no remote I/O, the MAU may be replaced by an I/O base. If there is no MAU, a terminator must be placed at the end of the branch.
Remote Node #1 Backup Fiber-Optic Cable (external)
A
B
A
Local I/O Bus Terminators
Cabinet Front
Cabinet Back

Figure 187: Controller Cabinet Components and Cabling (local and remote I/O)

30.3.2 CONTROLLER BACKPLANE (CBO)

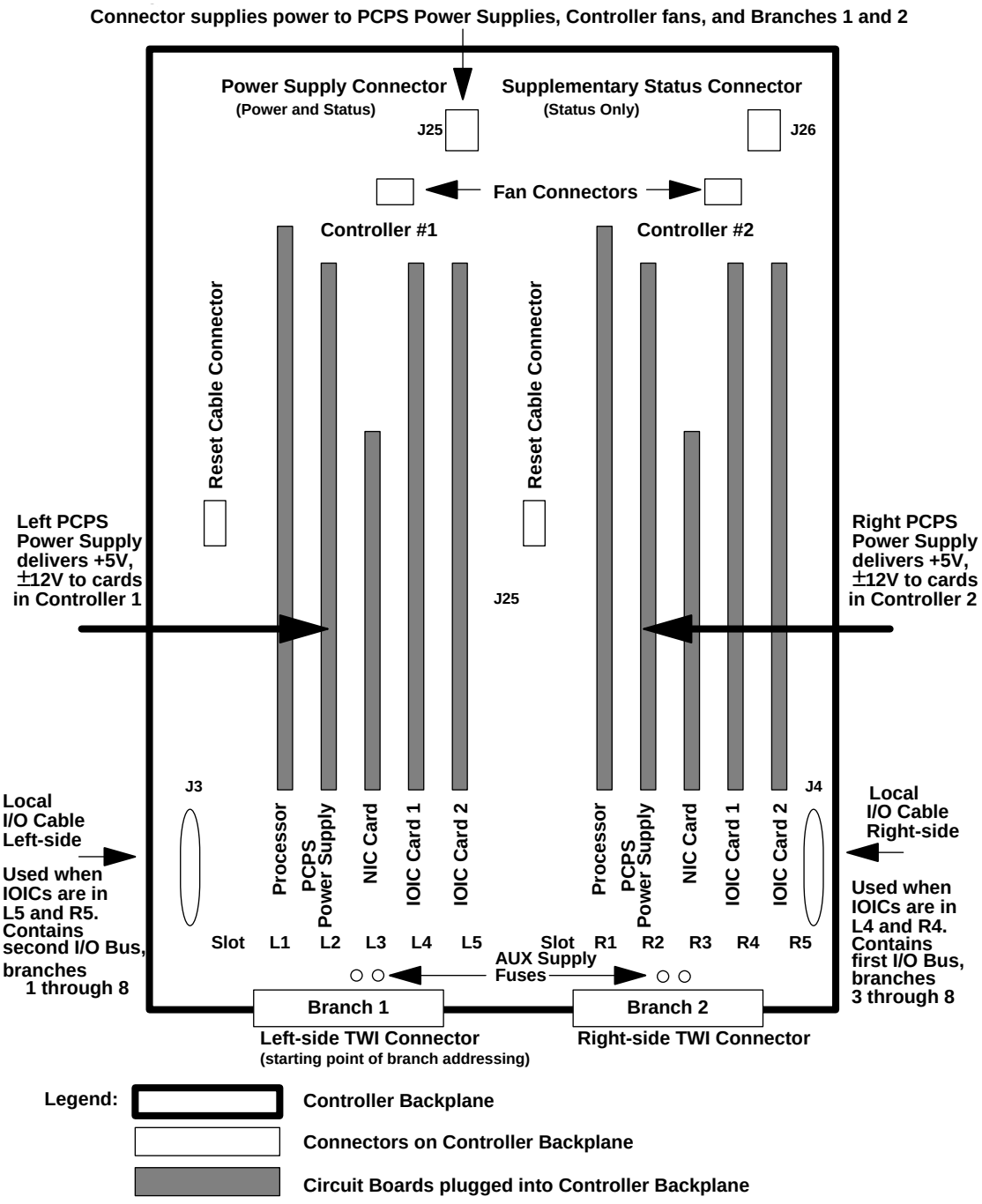

Connector supplies power to PCPS Power Supplies, Controller fans, and Branches 1 and 2
Power Supply Connector
(Power and Status)
J25
Supplementary Status Connector
(Status Only)
J26
Fan Connectors
Controller #1
Controller #2
Reset Cable Connector
Reset Cable Connector
Left PCPS Power Supply delivers +5V, ±12V to cards in Controller 1
Right PCPS Power Supply delivers +5V, ±12V to cards in Controller 2
J25
J3
J4
Local I/O Cable Left-side
Used when IOICs are in L5 and R5. Contains second I/O Bus, branches 1 through 8
Local I/O Cable Right-side
Used when IOICs are in L4 and R4. Contains first I/O Bus, branches 3 through 8
Processor
PCPS Power Supply
NIC Card
IOIC Card 1
IOIC Card 2
Slot L1 L2 L3 L4 L5
Slot R1 R2 R3 R4 R5
AUX Supply Fuses
Branch 1
Branch 2
Left-side TWI Connector
(starting point of branch addressing)
Right-side TWI Connector
Legend:
Controller Backplane
Connectors on Controller Backplane
Circuit Boards plugged into Controller Backplane

Figure 188: Controller Backplane (CBO)

30.3.3 MAU WITH TYPICAL FIBER-OPTIC CONNECTOR PAIRS

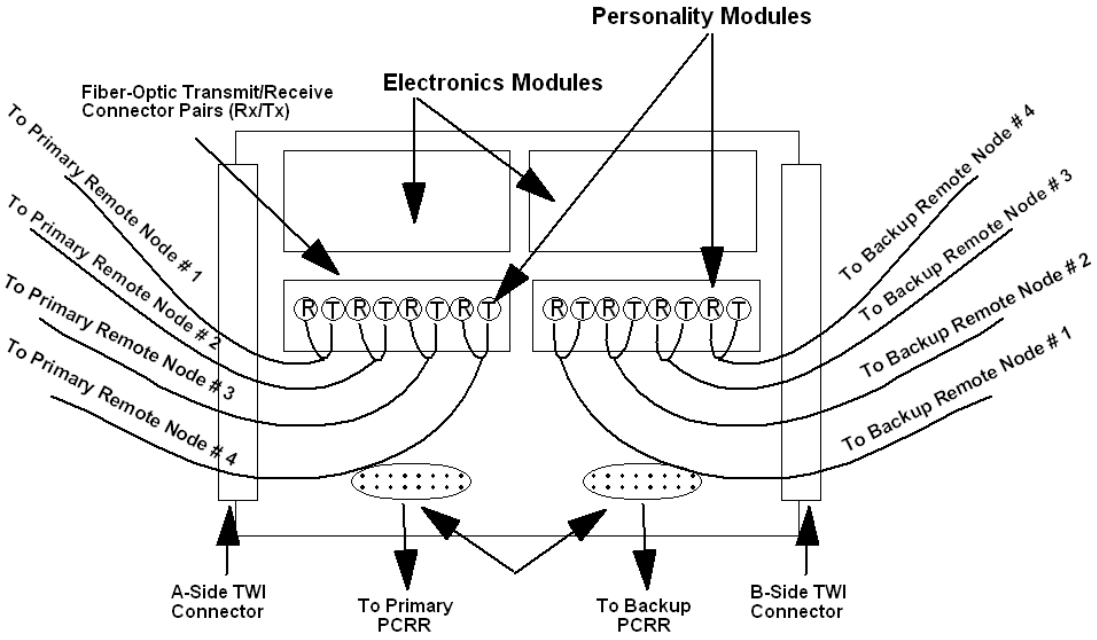


Figure 189: MAU with Typical Fiber-Optic Connector Pairs

30.3.4 EXAMPLE OF TYPICAL MAU CABLE CONNECTIONS TO REMOTE NODES

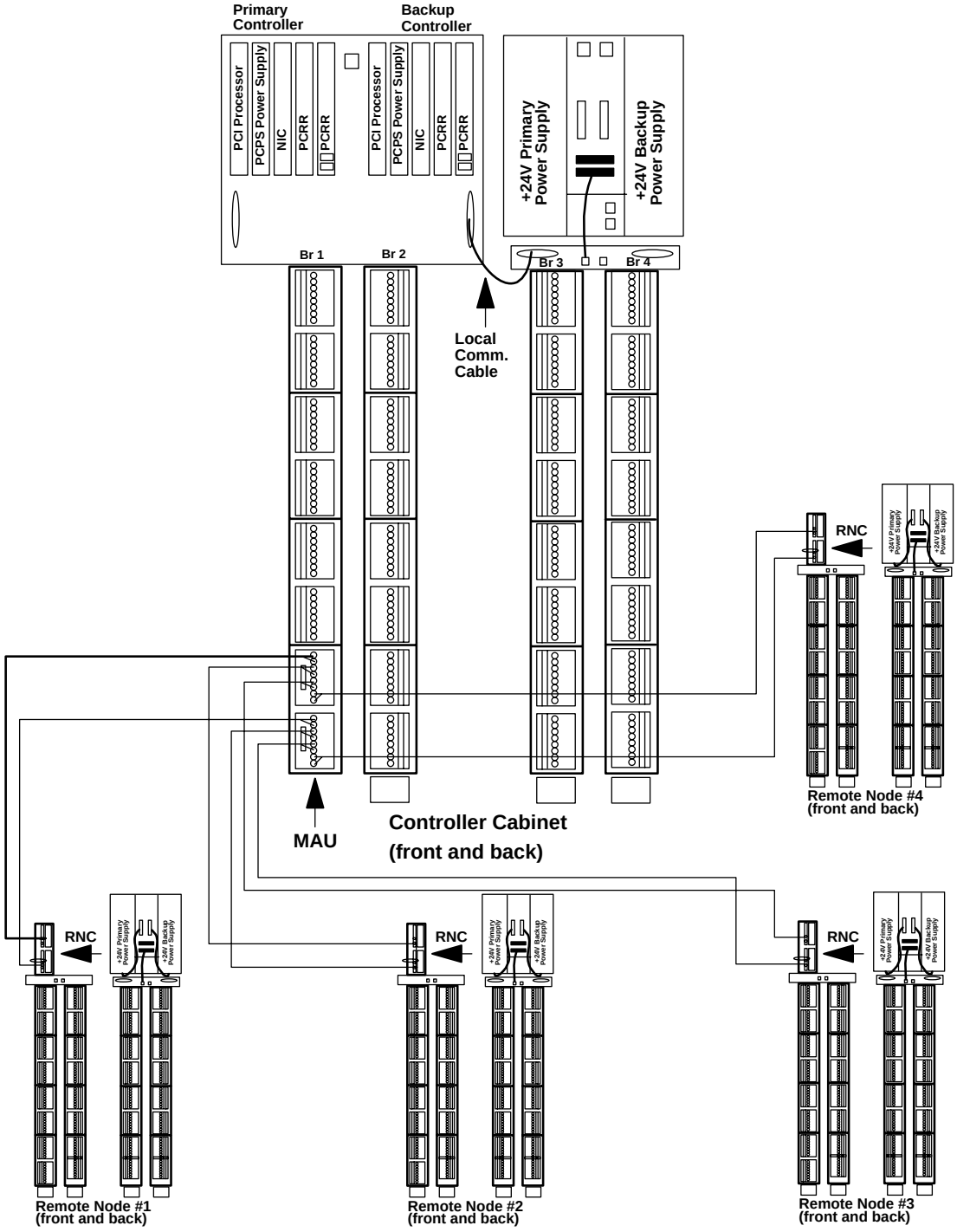


Figure 190: Example of Typical MAU Cable Connections to Remote Nodes

30.4 REMOTE NODE CABINET COMPONENTS

The Ovation Remote Node (see page 505) cabinet, located remotely from the Controller cabinet contains the following:

- Power Supply - DIN Rail Mounted. Generates +24V to power the electronics in the Remote Node Cabinet, as well as +24V auxiliary power. Two are required for redundancy.
- Remote Node Controller (RNC) Module (see page 506) - Provides a point of attachment for remote
  I/O media used to transfer messages between the remote node and the MAU. There are only two Remote Node Controller Modules per remote node (one primary, one backup), regardless of the number of cabinets at the node. The module translates messages from the remote I/O bus into local I/O bus cycles that can be directed to as many as eight branches of local I/O modules.

  The following components comprise the Remote Node Controller Module:

  - ☐ Remote Node Electronics Module **(1C31203)** - Prepares messages received from the remote I/O Controller for the local I/O modules at the remote node. When an I/O module responds to the message, the module prepares the response to be sent back to the Controller over the fiber-optic media.
  - ☐ Remote Node Personality Module **(1C31204G01 for 850 nm optics/1C31204G03 for 1300 nm optics)** - Houses the Remote Node Personality Board (PAU) which provides connectors for the media used to transmit and receive remote messages between the Controller and remote node. Group 1 modules provide fiber-optic connections; (future plans are that group 2 modules provide an AUI port used to connect to third party transceivers). Power supply monitoring circuitry of the +24V redundant supplies is located on this module and is reported back to the electronics module to flag failure of the primary or backup supply.
  - ☐ Remote Node Controller Base **(1C31205)** - This unique base holds a maximum of two Remote Node Modules and interfaces directly to two I/O branches. It provides a rotary switch for node addressing and a D-connector for interfacing to as many as six additional I/O branches using a local I/O communications cable. The RNC base unit is connected to the Remote Node Transition Panel described below.
- Remote Node Transition Panel **(see page 506) (TND - 4D33924)** - Interconnects the RNC base, Remote Power Supply Module (if used), and the branches of local I/O in a single Remote Node cabinet. The Remote Node Transition Panel (TND) also provides connectors for DIN Rail Mounted +24V Supplies or auxiliary supplies to be wired into the remote node.
- Power Distribution Module **(see page 509) (PDM - 5A26304)** - Provides connectors for cables used to distribute +24V to the Redundant RNC, and +24V and auxiliary power to the branches of I/O.
- Standard I/O Modules and Base (see page 510) - Standard Ovation I/O modules which interface to remote field devices when placed in the Remote Node cabinet.
- Relay Output Module and Base (see page 511) - Relay Output I/O modules which interface to remote field devices when placed in the Remote Node cabinet.
- I/O Dual Branch Transition Panel (see page 512) (ROP - 4D33922) - Connects to two branches of I/O, providing a point to bring in +24V redundant power, auxiliary power, and the local I/O communications bus.

  Connections are provided on the I/O Transition Panel to daisy-chain the local I/O communications bus from one ROP to the next (up to eight I/O branches **maximum** may be daisy-chained (see page 516) together.

- I/O Single Branch Transition Panels (see page 513) **(Top - RRP 3A99252; Bottom - RRB 3A99253) -** Used with Relay Output modules for a single I/O branch of up to eight relay bases.

  Supplies +24V redundant power, auxiliary power, and local communications bus to the branch. Mounted at the top/bottom of the extended cabinet (see page 513). Only one I/O branch is used and branches 2 through 8 are passed on.

- I/O Branch Terminator Board A or B **(1B30023)** - Connects to the A/B-side of a standard I/O base (see page 505) at the end of a branch to terminate the I/O bus.

30.4.1 TYPICAL REMOTE NODE CABINET

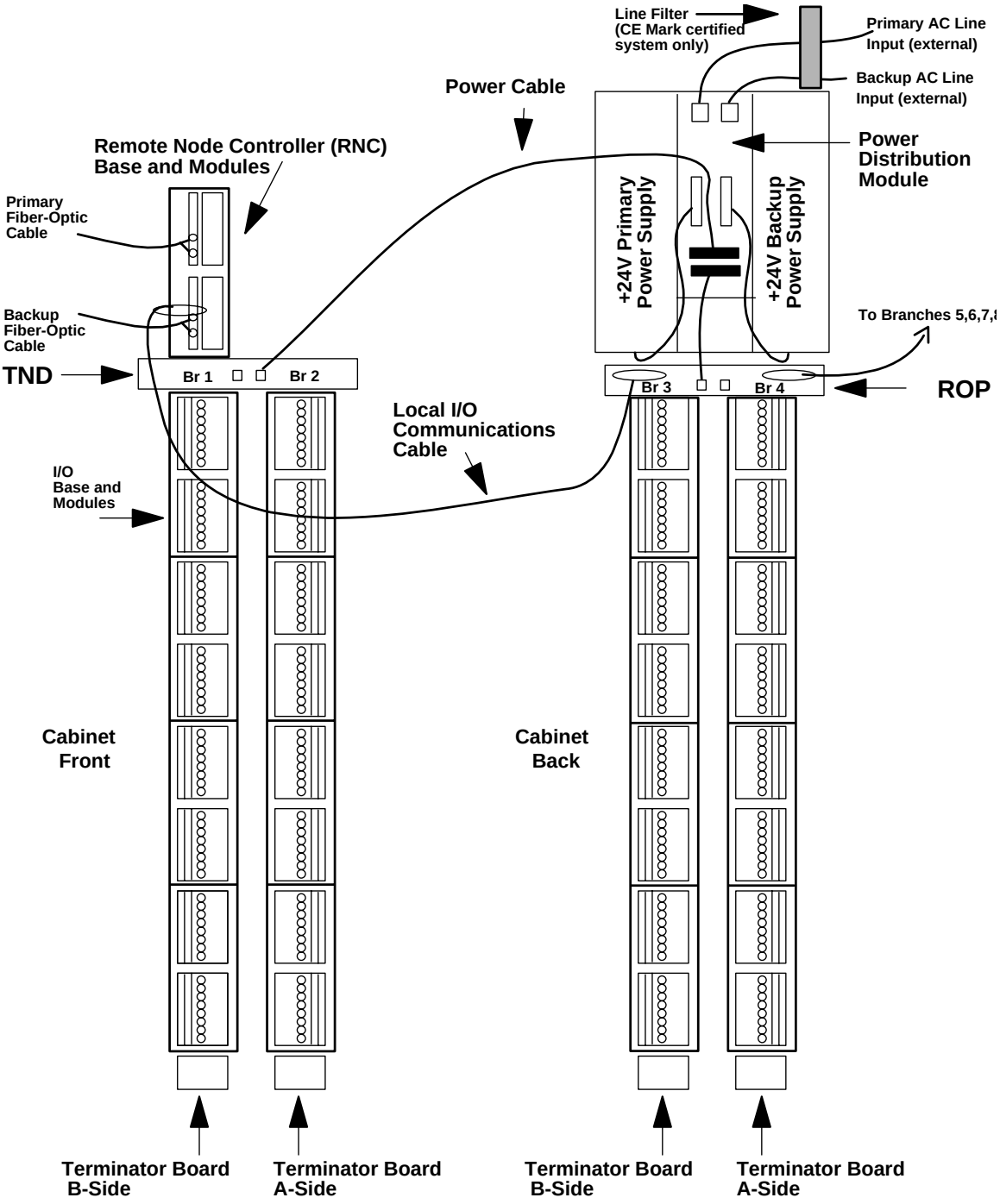


Figure 191: Typical Remote Node Cabinet

30.4.2 REMOTE NODE CONTROLLER (RNC)

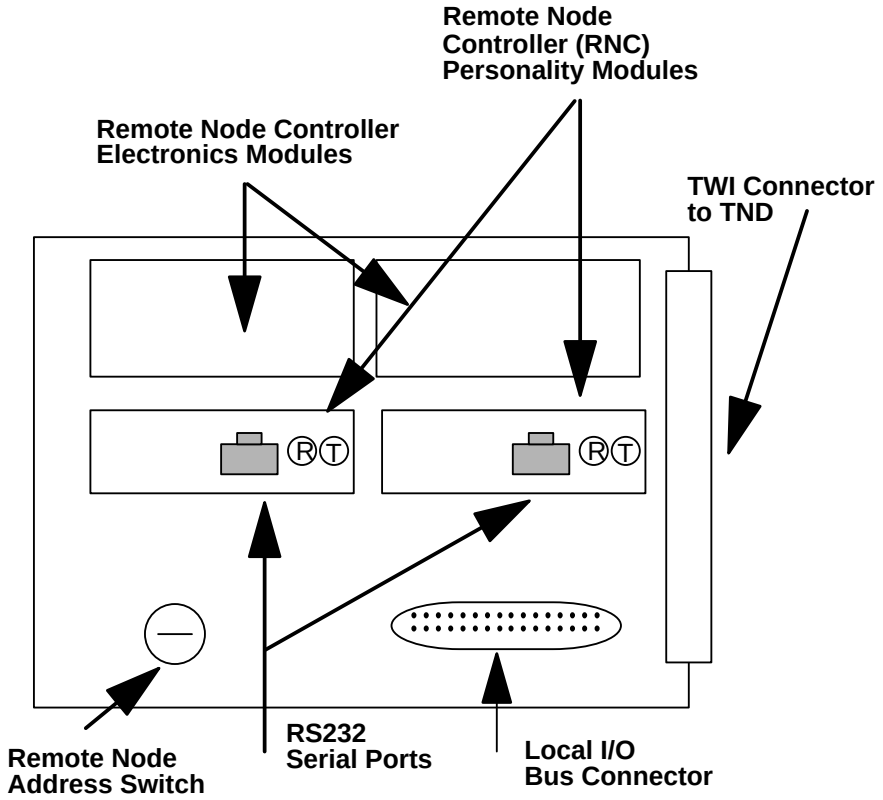


Figure 192: Remote Node Controller (RNC)

30.4.3 REMOTE NODE TRANSITION PANEL (TND)

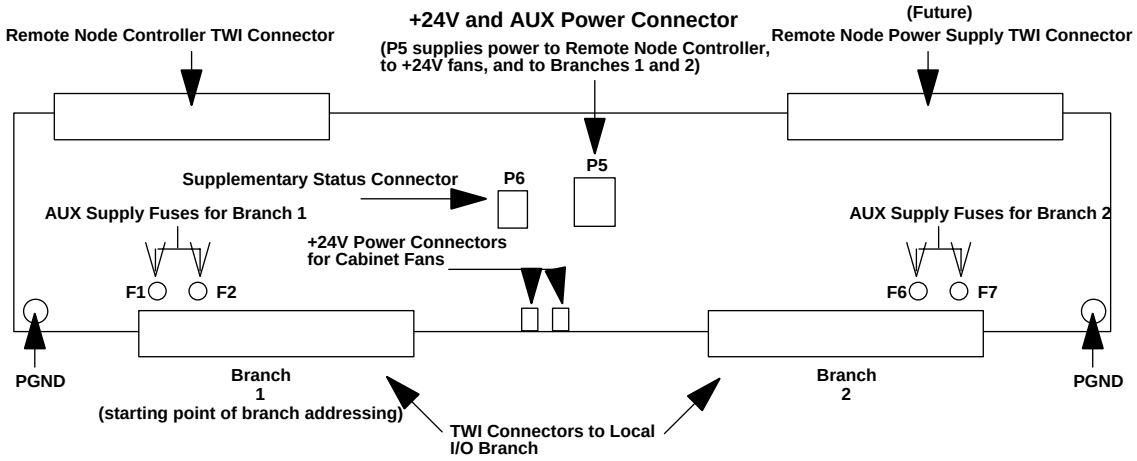


Figure 193: Remote Node Transition Panel (TND)

30.5 Extended I/O Cabinet Components

The Ovation I/O Extended cabinet contains the following:

Note: *Refer to the* Planning and Installing Your Ovation System *manual that is appropriate for your system for additional cabinet and cable information.*

- Power Supply - DIN Rail Mounted. Generates +24V to power the electronics in the Remote I/O Controller Cabinet, as well as +24V auxiliary power. Two are required for redundancy.
- Power Distribution Module **(see page 509) (5A26304)** - Provides connectors for cables used to distribute +24V to the Redundant RNC and to branches of local I/O.
- Standard I/O Modules and Base (see page 510) - Standard Ovation I/O modules which interface to field devices.
- Relay Output Module and Base (see page 511) - Relay module base, 1.5 times larger than a standard I/O base unit, containing electronics module and relays to control field devices.
- I/O Dual Branch Transition Panel (see page 512) (ROP - 4D33922) - Connects to two branches of I/O, providing a point to bring in +24V redundant power, auxiliary supplies, and the local I/O communications bus.

  Connections are provided on the I/O Transition Panel to daisy-chain the local I/O communications bus from one ROP to the next (up to eight I/O branches **maximum** may be daisy-chained together).

- I/O Single Branch Transition Panels (see page 513) **(Top - RRP 3A99252; Bottom - RRB 3A99253)** - Used with Relay Output modules for a single I/O branch of up to eight relay bases.

  Supplies +24V redundant power, auxiliary power, and local communications bus to the branch. Mounted at the top/bottom of the extended cabinet. Only one I/O branch is used and remaining branches are passed on.

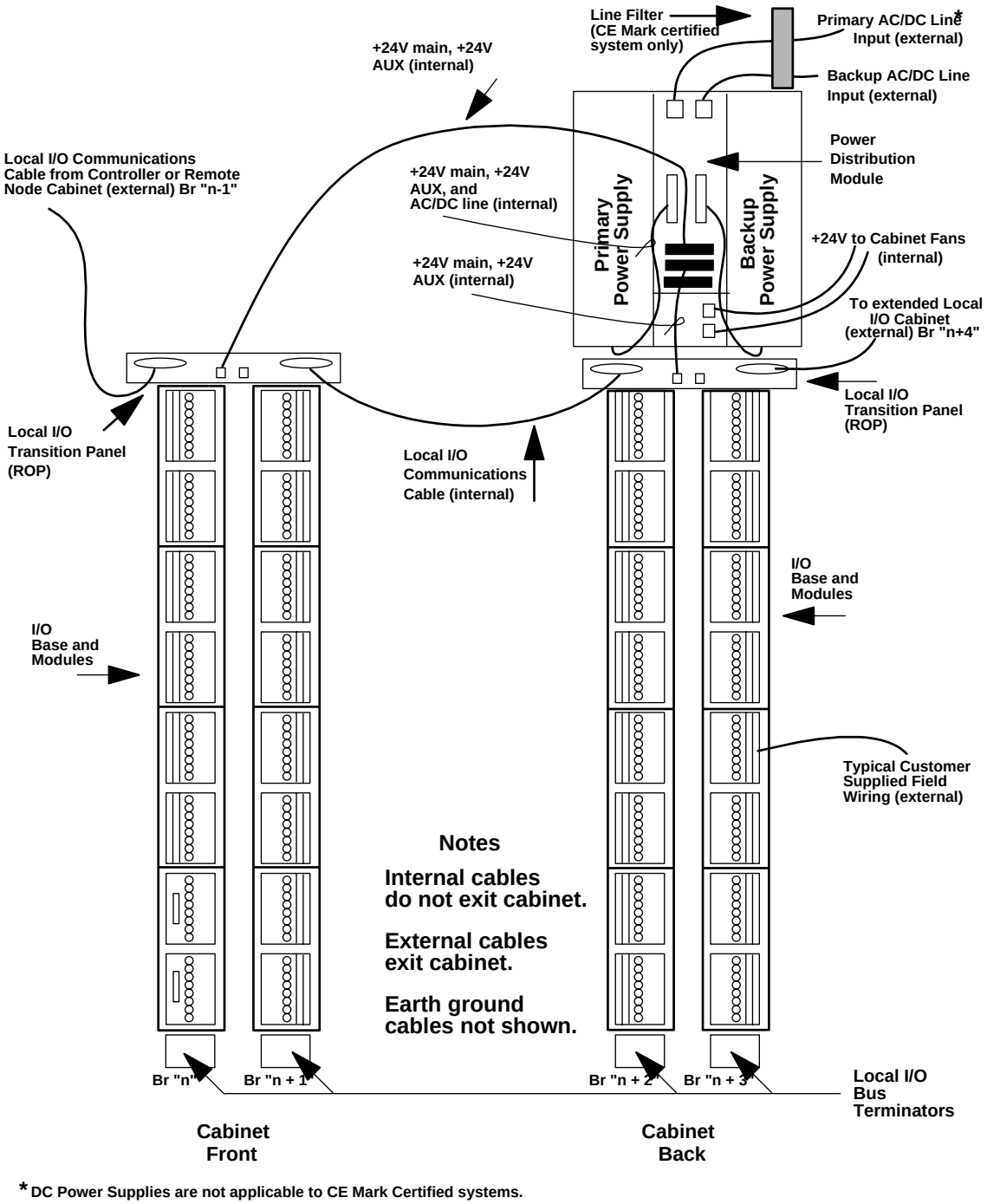

Line Filter (CE Mark certified system only)
Primary AC/DC Line Input (external)*
Backup AC/DC Line Input (external)
+24V main, +24V AUX (internal)
Power Distribution Module
Local I/O Communications Cable from Controller or Remote Node Cabinet (external) Br "n-1"
+24V main, +24V AUX, and AC/DC line (internal)
Primary Power Supply
Backup Power Supply
+24V to Cabinet Fans (internal)
+24V main, +24V AUX (internal)
To extended Local I/O Cabinet (external) Br "n+4"
Local I/O Transition Panel (ROP)
Local I/O Transition Panel (ROP)
Local I/O Communications Cable (internal)
I/O Base and Modules
I/O Base and Modules
Typical Customer Supplied Field Wiring (external)
Notes
Internal cables do not exit cabinet.
External cables exit cabinet.
Earth ground cables not shown.
Br "n"
Br "n + 1"
Br "n + 2"
Br "n + 3"
Local I/O Bus Terminators
Cabinet Front
Cabinet Back
* DC Power Supplies are not applicable to CE Mark Certified systems.

Figure 194: Ovation Extended I/O Cabinet (illustrating cables and Standard I/O)

30.5.1 CABINET COMPONENTS (CONTROLLER, REMOTE NODE, AND EXTENDED CABINET)

The following figures illustrate components that may be contained in Controller cabinets, remote node cabinets, and extended cabinets:

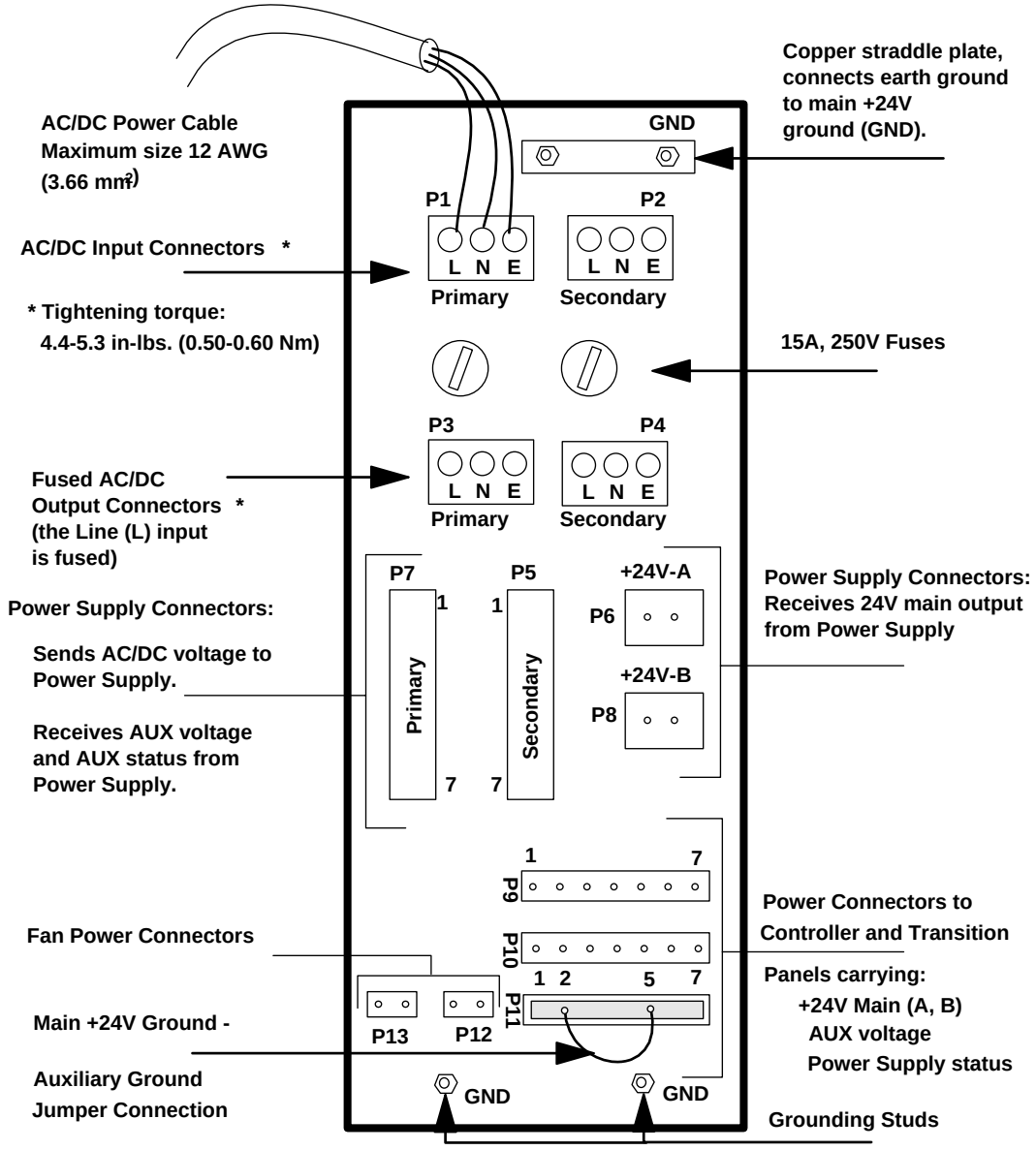


Figure 195: Ovation Power Distribution Module (PDM)

30.5.2 OVATION STANDARD I/O MODULES AND BASE UNITS

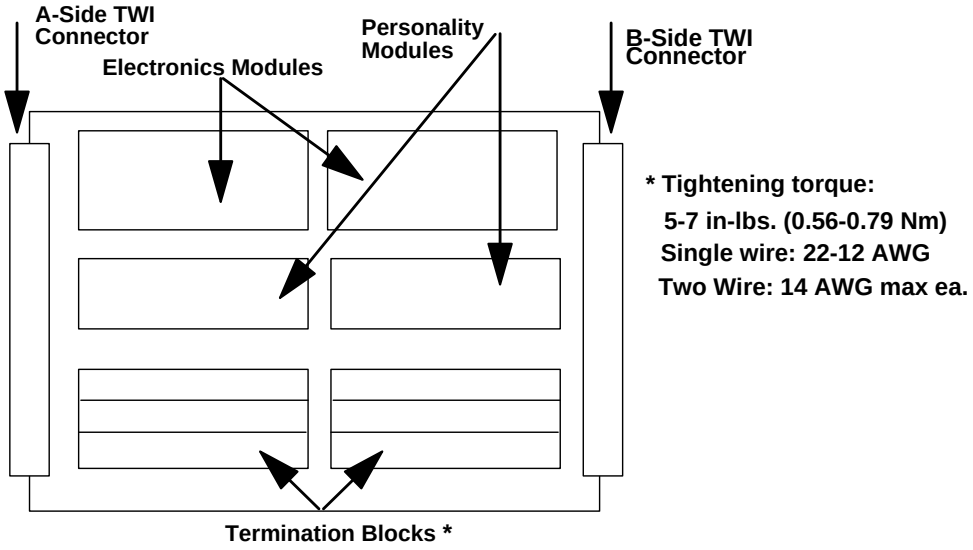


Figure 196: Ovation Standard I/O Modules and Base Units

30.5.3 RELAY OUTPUT MODULES AND BASES

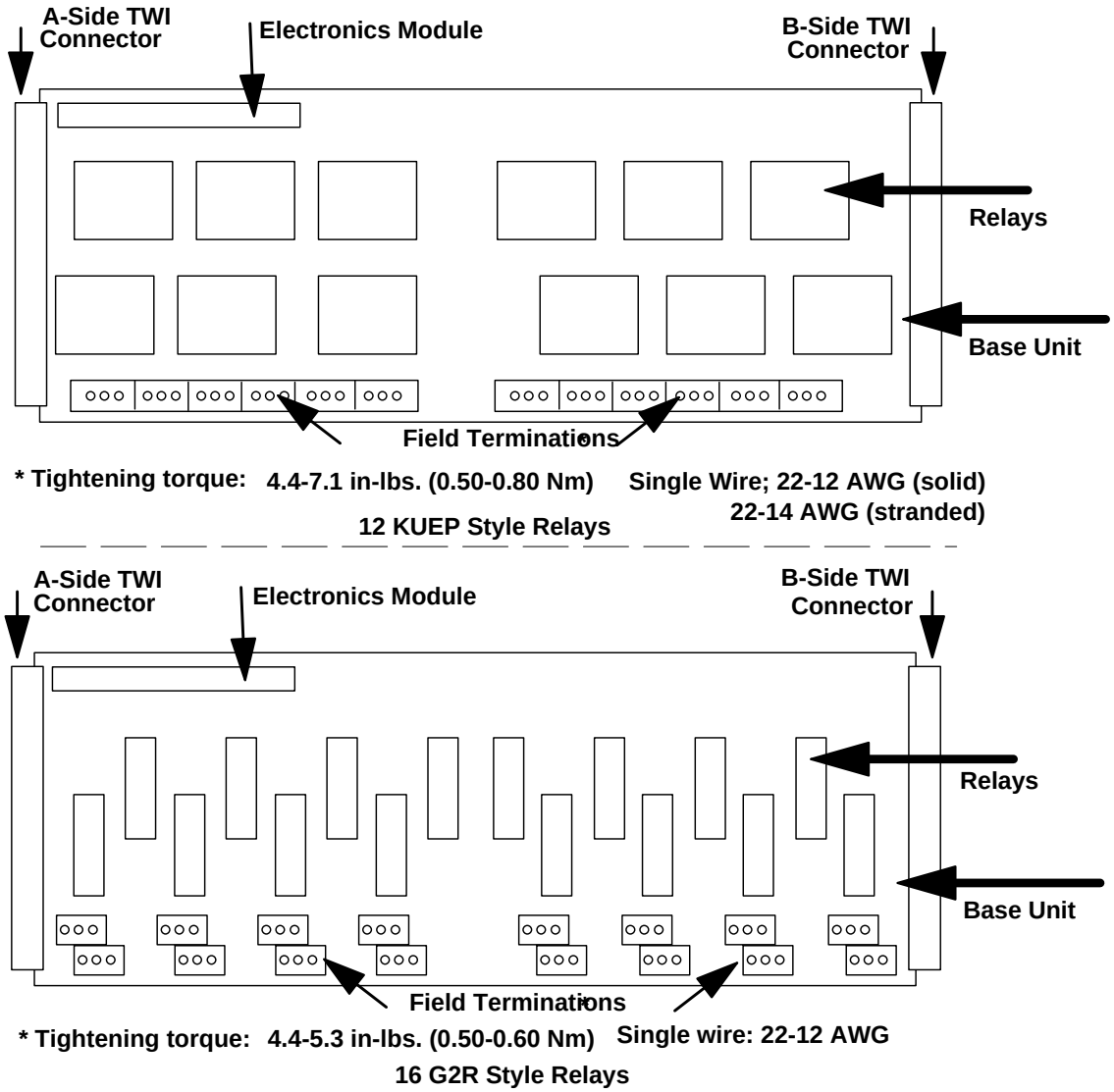


Figure 197: Relay Output Modules and Bases

30.5.4 I/O DUAL BRANCH TRANSITION PANEL (ROP)

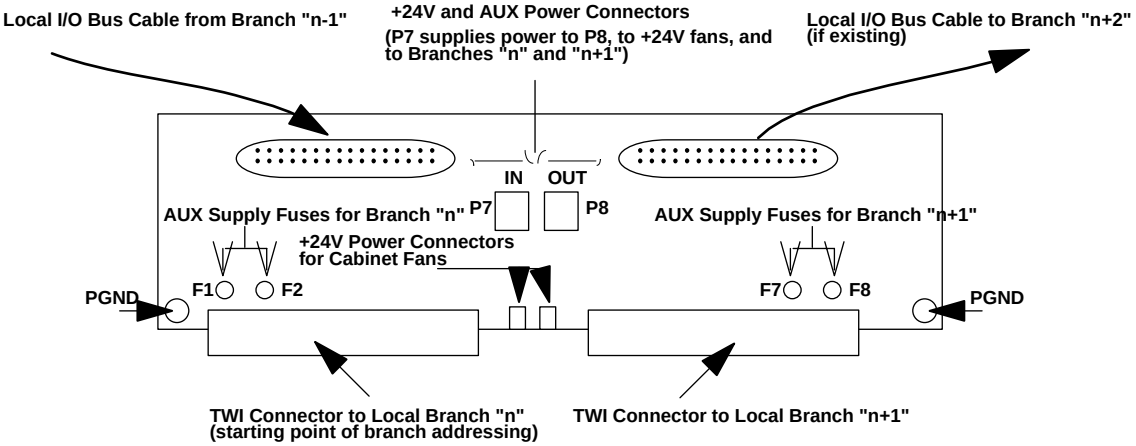

Local I/O Bus Cable from Branch "n-1"
+24V and AUX Power Connectors
(P7 supplies power to P8, to +24V fans, and to Branches "n" and "n+1")
Local I/O Bus Cable to Branch "n+2" (if existing)
IN
OUT
P7
P8
AUX Supply Fuses for Branch "n"
AUX Supply Fuses for Branch "n+1"
+24V Power Connectors for Cabinet Fans
F1
F2
F7
F8
PGND
PGND
TWI Connector to Local Branch "n" (starting point of branch addressing)
TWI Connector to Local Branch "n+1"

Figure 198: I/O Dual Branch Transition Panel (ROP)

30.5.5 OVATION I/O SINGLE BRANCH TRANSITION PANELS

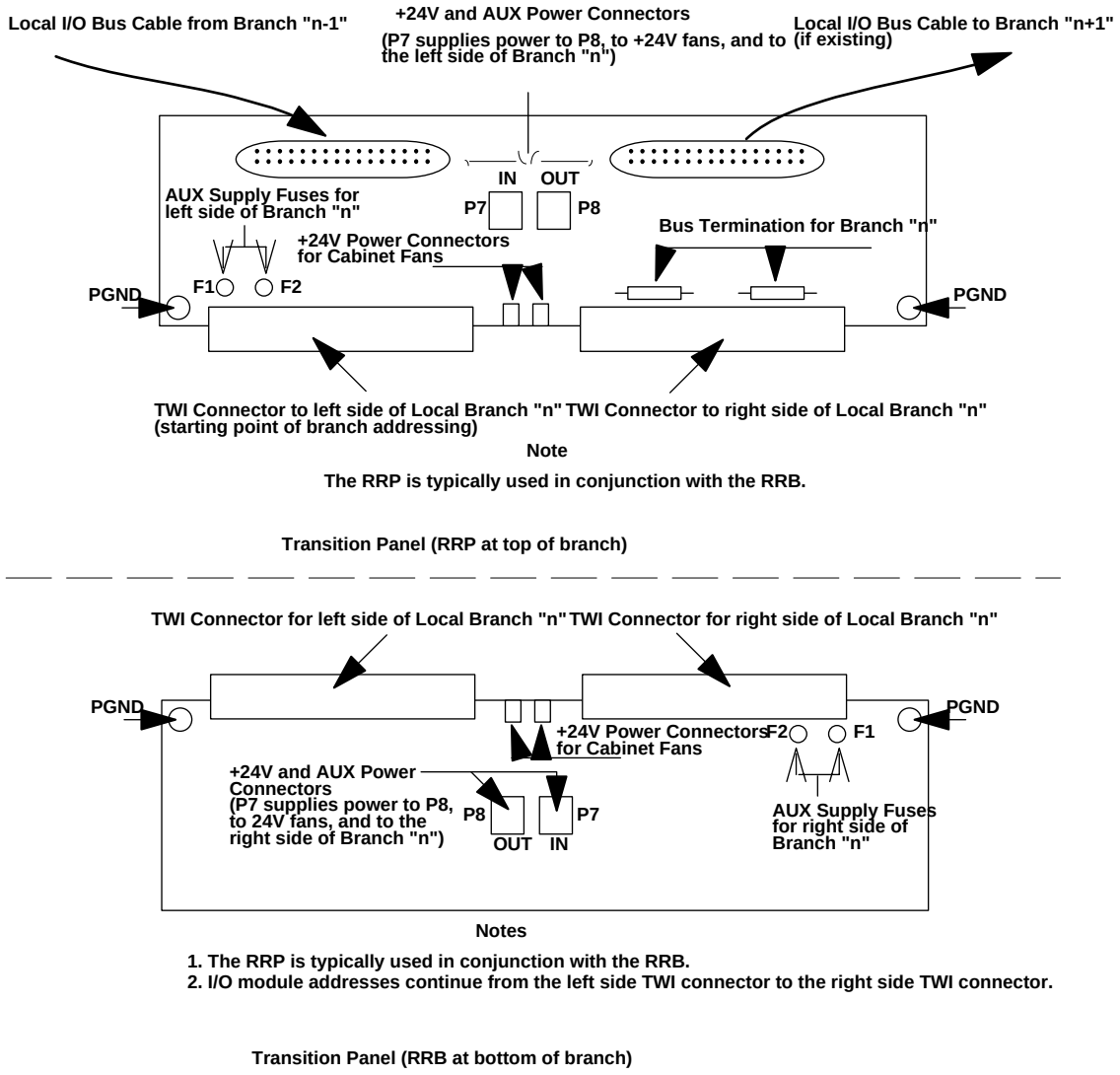

Local I/O Bus Cable from Branch "n-1"
+24V and AUX Power Connectors
(P7 supplies power to P8, to +24V fans, and to the left side of Branch "n")
Local I/O Bus Cable to Branch "n+1" (if existing)
IN
OUT
AUX Supply Fuses for left side of Branch "n"
P7
P8
Bus Termination for Branch "n"
+24V Power Connectors for Cabinet Fans
PGND
F1
F2
PGND
TWI Connector to left side of Local Branch "n" (starting point of branch addressing)
TWI Connector to right side of Local Branch "n"
Note
The RRP is typically used in conjunction with the RRB.
Transition Panel (RRP at top of branch)
TWI Connector for left side of Local Branch "n"
TWI Connector for right side of Local Branch "n"
PGND
PGND
+24V Power Connectors for Cabinet Fans
F2
F1
+24V and AUX Power Connectors (P7 supplies power to P8, to 24V fans, and to the right side of Branch "n")
P8
P7
OUT
IN
AUX Supply Fuses for right side of Branch "n"
Notes
1. The RRP is typically used in conjunction with the RRB.
2. I/O module addresses continue from the left side TWI connector to the right side TWI connector.
Transition Panel (RRB at bottom of branch)

Figure 199: Ovation I/O Single Branch Transition Panels

30.6 GENERAL REQUIREMENTS FOR I/O CABLE

30.6.1 I/O COMMUNICATIONS CABLE (5A26141)

This cable allows you to expand local I/O to additional branches by daisy-chaining connections between either the Controller backplane or Remote Node Controller Transition panel and additional local I/O Transition panels.

Length: 9.1 meters maximum (30 ft).

AUI Cable (5A26147)

The PCRR and Media Attachment Module are connected via an AUI cable. This cable meets the electrical specifications stated in the ANSI/IEEE 802.3 standard for Local Area Networks. The cable should be long enough to reach the length of the cabinet.

Length: Approximately 1.5 meters (5 ft).

Fiber-Optic Cable (3A98763 - Green) (3A98764 - Yellow)

The standard configuration of the Ovation Remote I/O Subsystem requires fiber-optic cables (with ST connectors) to connect the MAU to a remote node.

For 850 nm optics, distances of up to 2 km are supported between the remote node and the Controller or a repeater (up to two repeaters per communications link).

For 1300 nm optics, distances of up to 4 km are supported between the remote node and the Controller.

30.7 Configuring Remote I/O Cabinets

30.7.1 Placing the MAU Module

The MAU module is located in an Ovation Controller cabinet or in a migrated WDPF DPU cabinet. The MAU plugs into a special base unit which can accommodate up to two modules per base. The base unit clamps onto the DIN rail, like standard I/O module bases.

MAU 1 and MAU 2 are two separate MAU modules which may be located anywhere in the Controller cabinet. One AUI cable connects (see page 515) MAU 1 to P1 on the PCRR, and a second AUI cable connects MAU 2 to P2 on the PCRR.

Note: *If you migrate a WDPF Q-Line remote I/O system to Ovation, a QOR card will replace the QRC card in the WDPF Remote Node. Be sure to connect the MAU* ***TX*** *ports to the QOR* ***RX*** *ports, and connect the MAU* ***RX*** *ports to the QOR* ***TX*** *ports.*

Refer to the applicable Remote Q-Line Installation Manual *for your system for information on remote Q-Line and the QOR card (only 850 nm optics, with 2 km maximum length, are available for remote Q-Line applications).*

The A-side and B-side of the MAU base unit terminates the local I/O bus, so the base must always be at the end of a branch when local I/O modules are located on the same branch.

The B-side of the MAU base also initiates base addressing for a branch of local I/O. If desired, multiple MAU base units may be connected together on a single branch. Since the MAU base unit terminates the local I/O bus, I/O Bus Termination cards are not required on the end of a branch that has an MAU.

Duplex fiber optic cables (see page 516) must be hooked between the MAU channels and their corresponding remote nodes with specific switch settings.

Connecting the AUI Cable

The Attachment Unit Interface (AUI) cable in the Controller cabinet is used to connect **P1** and **P2** on the PCRR card to an MAU transceiver. This transceiver translates signals between the PCRR and the fiber-optic media that is used to connect remote nodes to the Controller.

P1 is the 15-pin D-connector on the PCRR closest to the front edge of the card where the LEDs are displayed. Controls and communication signals for nodes 1-4 are accessible through P1 on the PCRR.

P2 is the 15-pin D-connector closest to the back edge of the card. Control and communication signals for nodes 5-8 are accessible through P2 on the PCRR.

One PCRR provides two ports for AUI cables. The AUI cable connects the PCRR to the MAU which provides the reception and transmission for the fiber-optic cables. Both AUI ports are used on a single PCRR if the PCRR is to control more than four remote nodes. This configuration requires two AUI cables per PCRR card.

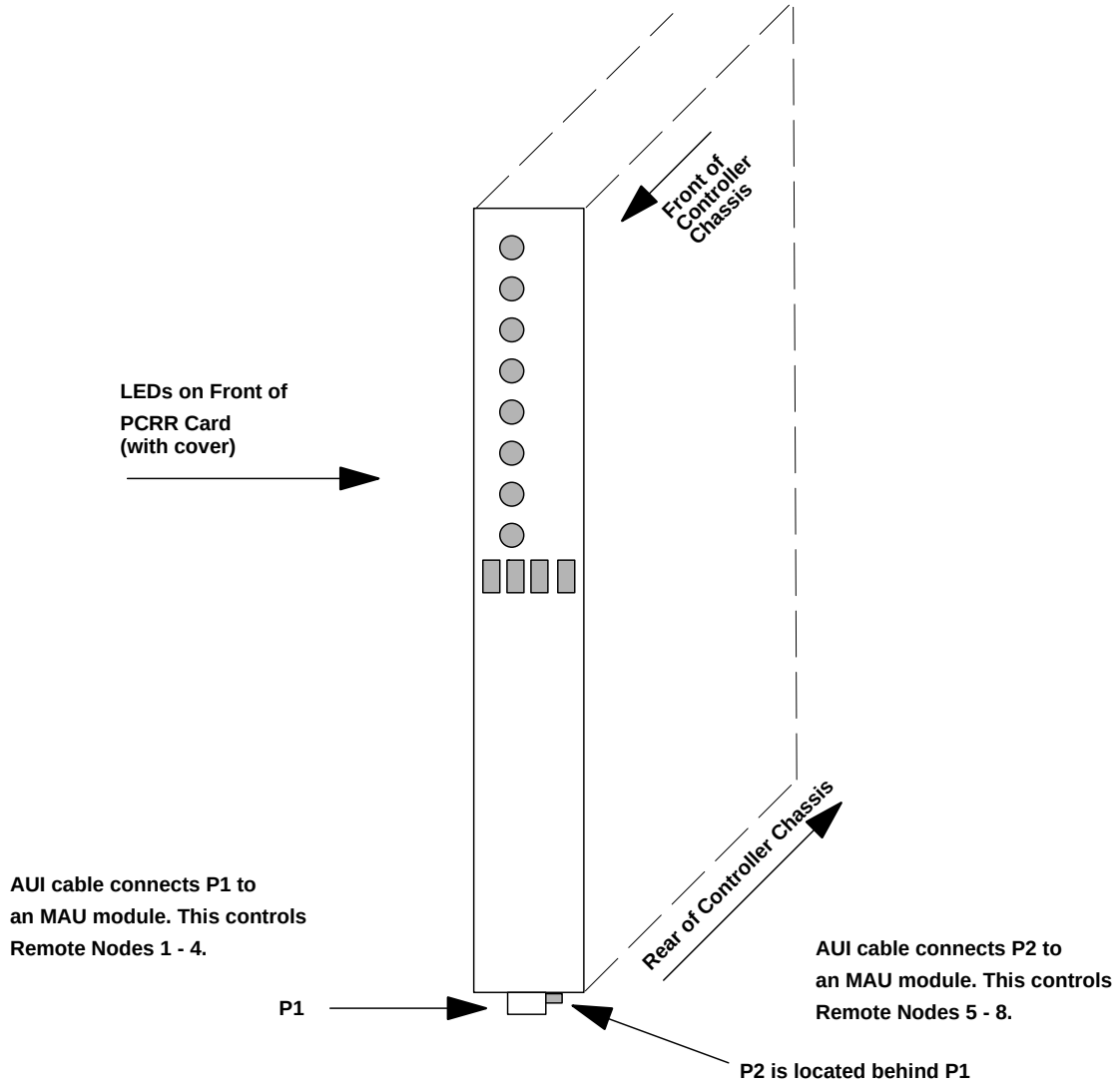

Front of Controller Chassis
LEDs on Front of PCRR Card (with cover)
AUI cable connects P1 to an MAU module. This controls Remote Nodes 1 - 4.
Rear of Controller Chassis
AUI cable connects P2 to an MAU module. This controls Remote Nodes 5 - 8.
P1
P2 is located behind P1

Figure 200: MAU Connections on PCRR Card

Remote Node Addressing Switch

A Controller PCRR card can control up to eight remote nodes. A 10-position rotary switch (located on an RNC backplane or on a QOR card) is used to assign a node address to the remote node.

Note: *Each remote Q-Line node is assigned all 244 possible DIOB addresses (08H through FBH).*

Positions 0-7 on the switch assign the lowest-to-highest order remote node from an addressing standpoint. Selecting position 8 or 9 on the switch is the same as assigning position 0 or 1, respectively, to a remote node.

The remote node must be connected to a specific channel of the Controller cabinet's MAU so that the PCRR communication signals can be directed to the proper node. Similarly, the AUI cable connecting the MAU to the PCRR must be connected to a specific port on the PCRR. The table below lists the control path for a PCRR controlling eight remote nodes through two MAUs.

Remote Node Addressing Switch

REMOTE NODE	PCRR PORT FOR AUI CABLE	MAU CHANNEL	REMOTE NODE'S ROTARY SWITCH SETTING
1	P1	MAU 1 - channel 1	0
2	P1	MAU 1 - channel 2	1
3	P1	MAU 1 - channel 3	2
4	P1	MAU 1 - channel 4	3
5 [1]	P2	MAU 2 - channel 1	4
6[1]	P2	MAU 2 - channel 2	5
7[1]	P2	MAU 2 - channel 3	6
8[1]	P2	MAU 2 - channel 4	7
Do not use.			8 or 9
[1] Optional for migration projects.			

Daisy-Chain Control of I/O Branches

Only one cabinet at a remote node contains redundant RNC modules which connect to two branches of I/O through the TND.

To control additional branches of I/O (up to six more branches), the local I/O bus (beginning at the RNC transition panel) is daisy chained to up to three ROPs. The ROPs may or may not be located in the same cabinet as the RNC. Note that each branch of I/O must be terminated with the proper I/O Branch Terminator Board (A or B). See Power Supply (see page 517) for a typical configuration of a remote node cabinet using daisy-chain control.

Power Supply

A +24V Power Supply is used to supply power to the Remote Node cabinet. The Power Supply is mounted on DIN Rails in the Remote Node cabinet. It is wired to the TND to provide power to the RNC and to the local I/O branches that are connected to the TND.

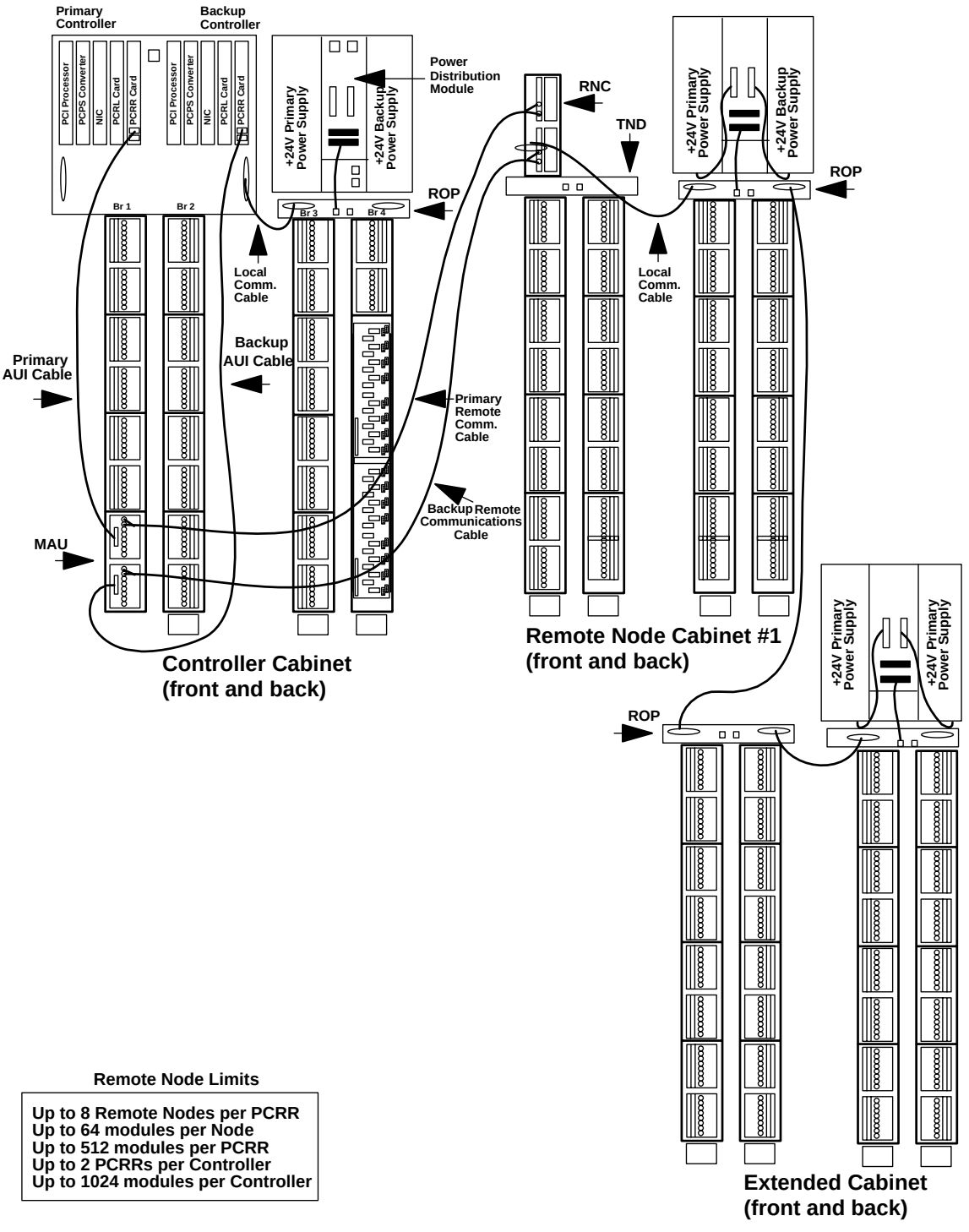


Figure 201: Example of Remote I/O Daisy-Chain Connections

30.8 DIAGNOSTIC LEDS

Three Controller modules used in the Ovation Remote I/O subsystem are equipped with LEDs that provide diagnostic displays. The modules are the PCRR, MAU, and the RNC.

30.8.1 LEDs for PCRR Card

Observe the following LED indicators for the PCRR card:

- **POWER** is lit when the Controller is on.
- The eight lights indicate the status of the eight nodes of the Controller Remote I/O.
- The Hexadecimal displays will display status and error codes (See *Ovation Error Codes*).

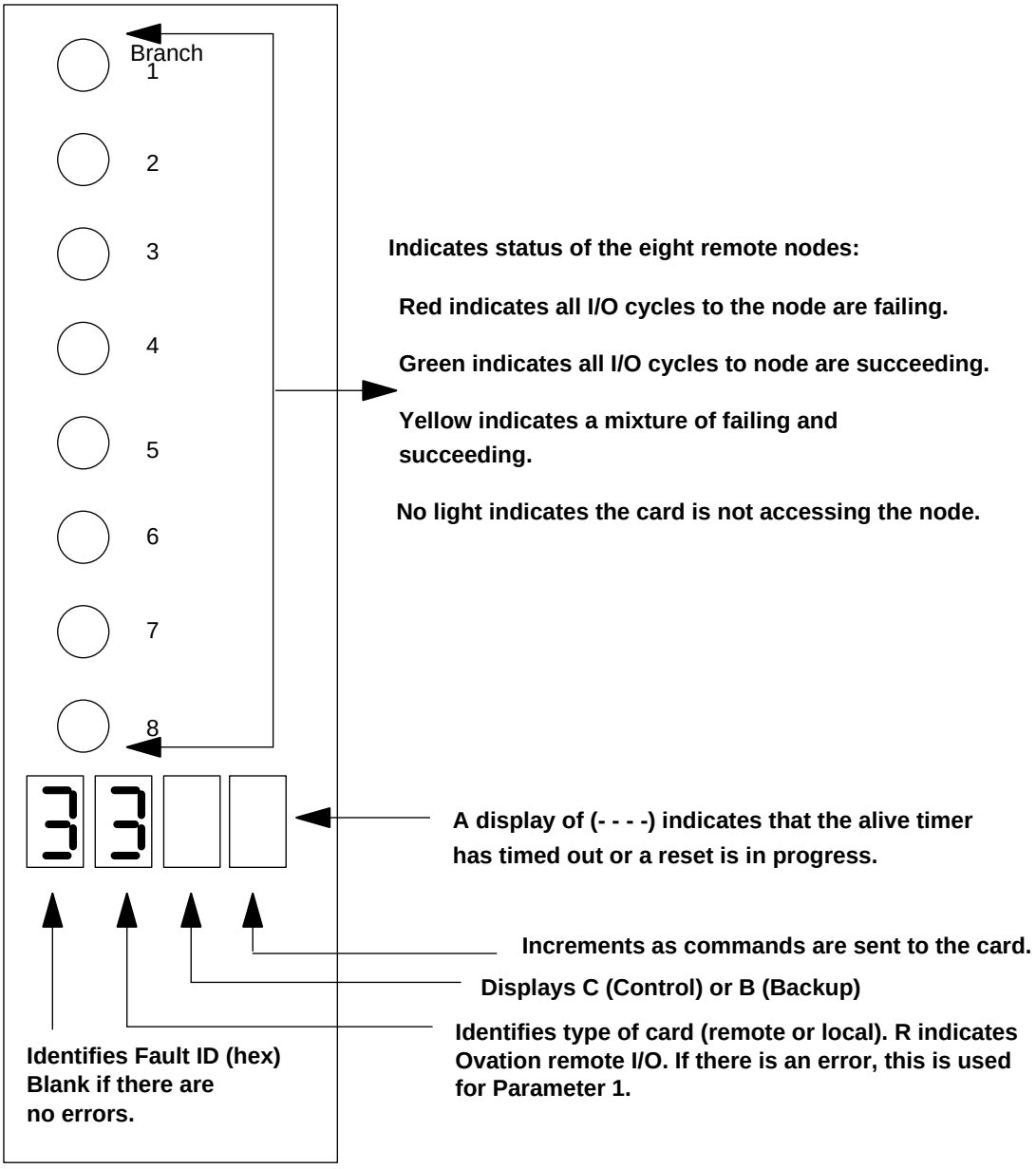

Branch
1
2
3
4
5
6
7
8
Indicates status of the eight remote nodes:
Red indicates all I/O cycles to the node are failing.
Green indicates all I/O cycles to node are succeeding.
Yellow indicates a mixture of failing and succeeding.
No light indicates the card is not accessing the node.
A display of (- - - -) indicates that the alive timer has timed out or a reset is in progress.
Increments as commands are sent to the card.
Displays C (Control) or B (Backup)
Identifies type of card (remote or local). R indicates Ovation remote I/O. If there is an error, this is used for Parameter 1.
Identifies Fault ID (hex) Blank if there are no errors.

Figure 202: PCRR Card for Ovation or Q-Line Remote I/O

MAU Module

The MAU Electronics Module front panel has LEDs to display the status of the MAU on-board power supply and the fiber-optic links between the MAU and each remote node.

The four LINK OK LEDs correspond with the four remote nodes connected to the MAU.

Note: *G01 MAU contains only two remote node connections and does have Link 3 and Link 4 LEDs.*

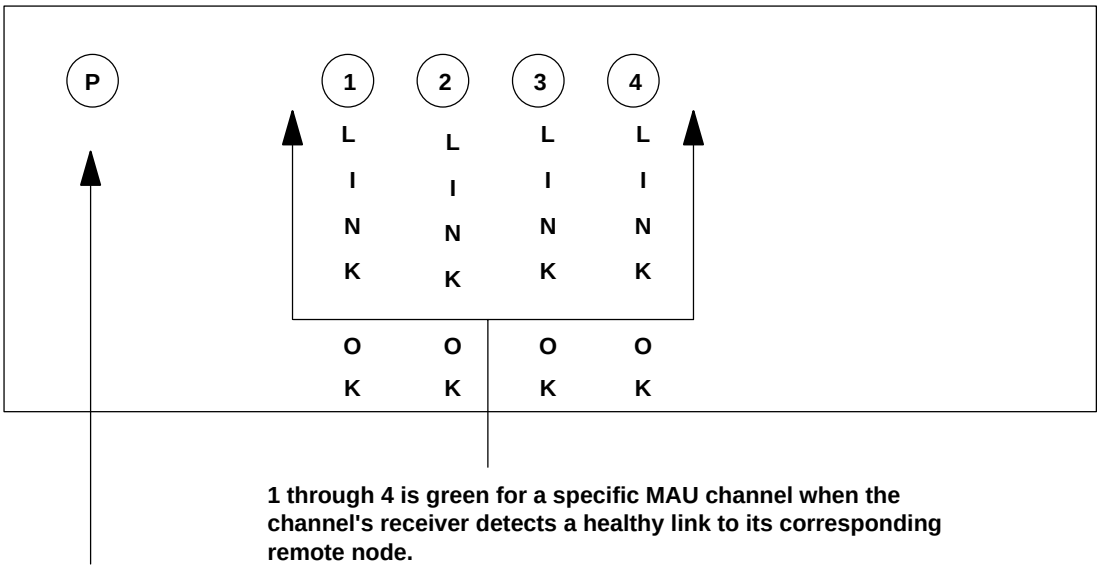

P
1
2
3
4
LINK OK
1 through 4 is green for a specific MAU channel when the channel's receiver detects a healthy link to its corresponding remote node.
P (Power) is green when the VCC is above the minimum acceptable threshold.

Figure 203: MAU LED Indicators

A healthy link between an MAU channel and a remote node is established when the transmitter of a powered-up remote node Controller is connected through a fiber-optic link to the receiver of its corresponding channel on the MAU. The transmitted signal received by the MAU must be strong enough to overcome low-light conditions to be seen as healthy by the MAU.

RNC Module

The RNC Electronics Module front panel has four LEDs to display statuses specific to the RNC and 16 LEDs to display statuses specific to the eight branches controlled by the RNC.

The LED states are defined in the following figure and table.

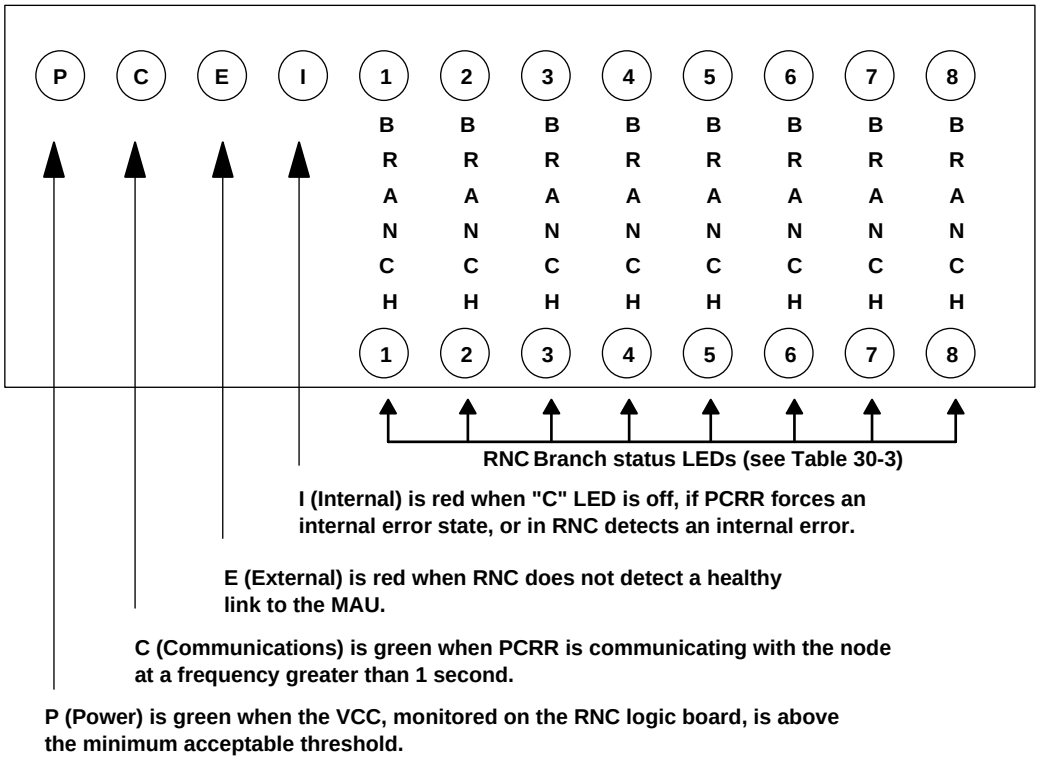

P
C
E
I
1
2
3
4
5
6
7
8
BRANCH
1
2
3
4
5
6
7
8
RNC Branch status LEDs (see Table 30-3)
I (Internal) is red when "C" LED is off, if PCRR forces an internal error state, or in RNC detects an internal error.
E (External) is red when RNC does not detect a healthy link to the MAU.
C (Communications) is green when PCRR is communicating with the node at a frequency greater than 1 second.
P (Power) is green when the VCC, monitored on the RNC logic board, is above the minimum acceptable threshold.

Figure 204: RNC LED Indicators

RNC Branch Status LED States

GREEN LED	RED LED	REMOTE NODE BRANCH STATUS
On	Off	All I/O cycles to the branch are succeeding.
On	On	Mixture of failing and succeeding I/O cycles to the branch.
Off	On	All I/O cycles to the branch are failing.
Off	Off	Branch is not being accessed.

APPENDIX A

Q-LINE CARD TYPES

A.1 Analog Types

Analog Data Types

DATA TYPE	DESCRIPTION
0	Not applicable
1	Not applicable
2	Not applicable
3	16 bit signed analog input card, card status =15, confide = 14, sign = 13, signed over range = 12, value = 11 to 0
4	16 bit unsigned analog input card, card status =15, unsigned over range = 13, value = 12 to 0
5	16 bit unsigned analog input card, value = 15 to 0
6	16 bit signed analog input card, card status = 0, sign = 15, unsigned over range = 1, value = 13 to 3
7	16 bit unsigned analog input card, card status =15 and 0, unsigned over range = 1, value = 13 to 3
8	16 bit unsigned analog input card, card status = 15, value = 11 to 0
9	16 bit unsigned analog output card, value = 15 to 0
10	16 bit signed analog output card, sign = 15, value = 14 to 4
11	16 bit unsigned analog output card, value = 15 to 4
12	16 bit unsigned analog output card, clamped at 16, value = 15 to 4
13	16 bit unsigned analog output card, scaled by.6 and biases + 800, value = 15 to 4
22	16 bit unsigned analog input card, card status = 15, value = 14 to 0

Analog Card Types

CARD	GROUP	WDPF II CARD TYPE	RANGE	DATA TYPE
QAA	G01	NA	-16 to +16mA (Position) +4 to +20 mA (Velocity)	0
	G02	NA	+4 to +20 mA (Velocity) -10 to +10 VDC (Voltage) Optional	0
QAH	G01	17	-10.24 to +10.235 V	6
	G02	18	-5.12 to + 5.117 V	6
	G03	19	0 to +10.237 V	7
	G04	20	0 to 5.119 V	7
QAI	G01	1	-20 to +20 mV	3
	G02	2	-50 to +50 mV	3
	G03	3	-100 to +100 mV	3
	G04	4	-500 to +500 mV	3
	G05	5	-1 to +1 V	3
	G06	6	-10 to + 10 V	3
	G07	7 or 9	0 to 20 mA	3
	G07A	NA	4 to 20 mA	3
	G08	8	-50 to +50 mV	3
QAM	G01	31	0 to 10 VDC (Output)	0
	G02	31	0 to 10 mA, 0 to +5 VDC (Output)	0
QAO	G01	21	0 to + 20.475 mA	12
	G01A	29	4.00 to + 20.475 mA	13
	G02	22	-0 to +10.2375 V	11
	G03	23	-10.24 to +10.235 V	10
	G04	24	0 to +5.1187 V	11
	G05	25	-5.12 1 to +5.1175 V	10
	G06	26	-10.24 to + 10.235 V	10
	G07	27	0 to + 20.475 mA	12
	G07A	NA	+4 to +20 mA	12
	G08	28	-10.24 to + 10.235 V	10
QAV	G01	1 or 54	-20 to +20 mV	3

CARD	GROUP	WDPF II CARD TYPE	RANGE	DATA TYPE
	G02	2 or 55	-50 to +50 mV	3
	G03	3 or 56	-100 to +100 mV	3
	G04	2	-50 to +50 mV	3
	G05	3	-100 to +100 mV	3
	G06	NA	-50 to +50 mV	3
	G07	NA	-20 to +20 mV (with temperature compensation)	3
	G08	NA	-50 to +50 mV (with temperature compensation)	3
	G09	NA	-100 to +100 mV (with temperature compensation)	3
QAW	G01	13 or 34	0 to +1 V	3
	G02	14 or 35	0 to +5 V	3
	G03	15	0 to +10 V	3
	G04	16	0 to +20 mA	3
	G04A	NA	+4 to +20 mA	3
	G05	NA	0 to +20 mA (self-powered)	3
	G05A	16	+4 to +20 mA	3
	G06	32	0 to +50 mA	3
	G06A	NA	+4 to +50 mA	3
QAX	G01	68 or 71	-20 to +20 mV	3
	G02	69 or 72	-50 to +50 mV	3
	G03	70 or 71	-100 to +100 mV	3
	G04	74	0 to +1 V	3
	G05	75	0 to +5 V	3
	G06	76	0 to +10 V	3
QFD	G01	88	-118.75 to +5000.625 mA	4
QLI	G01	51	0 to 10VDC (Analog Input/Output)	3
	G02	52	0 to 5 VDC (Analog Input) 0 to 10 VDC (Analog Output)	3
	G03	53	0 to 20mA (Analog Input) 4 to 20 mA (Analog Output)	3
QPA	G01	36	Pulses	5

CARD	GROUP	WDPF II CARD TYPE	RANGE	DATA TYPE
	G02	36	Pulses	5
	G03	36	Pulses	5
	G04	36	Pulses	5
QRT	G01	NA	0 to + 10 mV	3
	G02	NA	0 to + 33 1/3 mV	3
QSD	G01	NA	Input: 20 V peak-to-peak 1 KHz sine wave (LVDT) Output: +/- 24 mA	0
QSR	G01	NA	0 to 100	8
	G02	NA	NA	8
	G03	NA	NA	8
	G04	NA	NA	8
QSS	G01	66	1.5, 1.8, 3.0, 3.6, 6.0, or 7.2 kHz	22

A.2 Digital Types

Digital Data Types

DATA TYPE	DESCRIPTION	DATA TYPE	DESCRIPTION
1	Standard digital input card	8	Not applicable
2	Standard digital output card	9	Not applicable
3	Not applicable	10	Not applicable
4	Not applicable	11	Not applicable
5	Not applicable	12	Not applicable
6	Not applicable	13	Not applicable
7	Not applicable	NA	NA

Digital Card Types

CARD	GROUP	DATA TYPE
QBI	G01	1
	G02	1
	G03	1
	G04	1
	G05	1
	G06	1
	G07	1
	G08	1
	G09	1
	G10	1
	G11	1
QBO	G01	2
	G02	2
	G03	2
	G04	2
	G05	2
QCI	G02	1
QDI	G01	1
	G02	1
	G03	1
	G04	1
	G05	1
	G06	1
	G07	1
	G08	1
	G09	1
	G10	1
	G11	1
QID	G01	1
	G02 (Low)	1

CARD	GROUP	DATA TYPE
	G02H (High)	1
	G03	1
	G04 (Low)	1
	G04H (High)	1
	G05	1
	G06 (Low)	1
	G06H (High)	1
	G07	1
	G08	1
	G09	1
	G10	1
	G11 (Low)	1
	G11H (High)	1
	G12	1
	G13 (Low)	1
	G13H (High)	1
	G14	1
	G15 (Low)	1
	G15H (High)	1
	G16	1
	G17	1
QSE	G01	1
	G02	1
QRO	G01 (Low)	2
	G01H (High)	2
	G02 (Low)	2
	G02H (High)	2
	G03 (Low)	2
	G03H (High)	2
	G04 (Low)	2
	G04H (High)	2

A.3 Packed Point Types

Packed Data Types

DATA TYPE	DESCRIPTION
1	Standard 16 bit digital input card
2	Standard 16 bit digital output card
3	Not applicable
4	Not applicable
5	Not applicable
6	Not applicable
7	Not applicable
8	Not applicable
9	Not applicable
10	Not applicable
11	Not applicable
12	Not applicable
13	Not applicable

Digital Card Types

CARD	GROUP	DATA TYPE
QBI	G01	1
	G02	1
	G03	1
	G04	1
	G05	1
	G06	1
	G07	1
	G08	1
	G09	1
	G10	1
	G11	1
QBO	G01	2
	G02	2

CARD	GROUP	DATA TYPE
	G03	2
	G04	2
	G05	2
QDI	G01	1
	G02	1
	G03	1
	G04	1
	G05	1
	G06	1
	G07	1
	G08	1
	G09	1
QDI	G10	1
	G11	1
QID	G01	1
	G02	1
	G03	1
	G04	1
	G05	1
	G06	1
	G07	1
	G08	1
	G09	1
	G10	1
	G11	1
	G12	1
	G13	1
	G14	1
	G15	1
	G16	1
	G17	1
QSE	G01	1
	G02	1

APPENDIX B

OVATION ELECTRONIC ID

B.1 Serial Number

The serial number provides a method for identifying and date coding the Ovation I/O module. This number is a single 10-digit decimal number representing when and where the module was manufactured.

The format used for the serial number is **DDDYYPNNNN** and is described in the following table

EID Serial Number

Code	Description	Range
DDD	Day of the year	001 - 366
YY	Year	00 - 99
P	Label printstation	0 - 9
NNNN	1 - 9999 roll-over counter Increments by one and rolls back to 0001 after reaching 9999.	0000 - 9999

For example, if a module was module 8322, manufactured at printstation 7, on day 43 of 2003, the serial number would be: **0430378322**,

where:

043 is the day of the year
03 is the year
7 is the label station
2 identifies that this module is the 8322 module labeled at station 7 for that day.

B.2 Index Number

The index number provides a description of the types and revisions of the two cards (Logic and Field) that make up an Ovation Electronics module. This number is a series of eight decimal numbers (separated by dots) that identifies the type of module and the revisions of the cards.

The format used by Ovation Electronics module for the index number is **MFC.MG.MR.LA.LR.FA.FR.CC.**

EID Index Number (Ovation I/O Modules)

Code	Description	Range	Number of Bits
MFC	Module Function Code [1]	001 - 254	8
MG	Module Assembly Group	00 - 63	6
MR	Module Assembly Revision	00 - 63	6
LA	Logic Card Artwork	00 - 31	5
LR	Logic Card Assembly Revision	00 - 63	6
FA	Field Card Artwork	00 - 31	5
FR	Field Card Assembly Revision	00 - 63	6
CC	Compatibility Code	00 - 63	6
[1] Refer to the following table for each Ovation I/O module.			

The format used by the I/O Controller cards (PCRL, PCRR, PCQL and QOR) for the index number is **MFC.MG.CR.CA** and is described in below**:**

EID Index Number (Ovation I/O Controller Modules)

Code	Description	Range	Number of Bits
MFC	Module Function Code [1]	001 - 254	8
CG	Controller Group	01 - 63	6
CR	Controller Assembly Revision	00 - 63	6
CA	Controller Artwork	00 - 31	5
[1] Refer to the following table for function codes for each Ovation I/O Controller module.			

Module Function Codes

Module Assembly	Module Type	Category	Function Code
1C31113	Analog Input (AI)	I/O Module	001
1C31129	Analog Output (AO)	I/O Module	002
1C31107	Digital Input (DI)	I/O Module	003
1C31122	Digital Output (DO)	I/O Module	004
1C31142	Contact Input (CI)	I/O Module	005
1C31157	Sequence of Events (SE)	I/O Module	006
1C31147	Pulse Accumulator (PA)	I/O Module	007
1C31166	Link Controller (LC)	I/O Module	008

Module Assembly	Module Type	Category	Function Code
1C31199	Servo Driver (SR)	I/O Module	009
1C31194	Valve Positioner (VP)	I/O Module	010
1C31189	Speed Detector (SD)	I/O Module	011
1C31203	Remote Node Controller (ND)	I/O Module	012
1C31179	Media Attachment Unit (AU) [1]	I/O Module	013
1C31161	RTD Input (RT)	I/O Module	014
1C31174	Loop Interface Controller (LI)	I/O Module	015
1C31219	Relay Output Electronics (ROE)	I/O Module	016
1C31232	Compact Digital Input (DI)	I/O Module	017
1C31234	Compact Contact Input (CI)	I/O Module	018
1C31233	Compact Sequence of Events (SE)	I/O Module	019
1C31224	14-bit Analog Input (AI14)	I/O Module	020
5X00058	HART Analog Input (HAI)	I/O Module	021
5X00062	HART Analog Output (HAO)	I/O Module	022
5X00070	High-Speed Analog Input (HSAI)	I/O Module	023
5X00106	Isolated HART Analog Input (IAH)	I/O Module	024
5X00119	8 Channel RTD Input (RTD)	I/O Module	025
3A99257	Q-line Remote Node Controller (QOR)	I/O Controller	250
3A99229	PCI to GBUS Interface (PGI)	PGI	251
3A99190	Remote Ovation I/O Interface (PCRR)	I/O Controller	252
3A99158	Local Ovation I/O Interface (PCRL)	I/O Controller	253
3A99141	Local Q-line I/O Interface (PCQL)	I/O Controller	254

[1] No on-board EID. Bar code label only.

B.3 I/O Module EID Programming Format

The EID is represented in the Electronics card of an I/O module as **five** 16-bit integers (words). These words are programmed into the card after it has been manufactured and tested.

B.3.1 SERIAL NUMBER

The entire 10-digit serial number is written as one number into two 16-bit words. The serial number is contained in the MH field of the Module (RM) Record Type and the Node (RN) Record Type (See the *Record Types Manual.)*

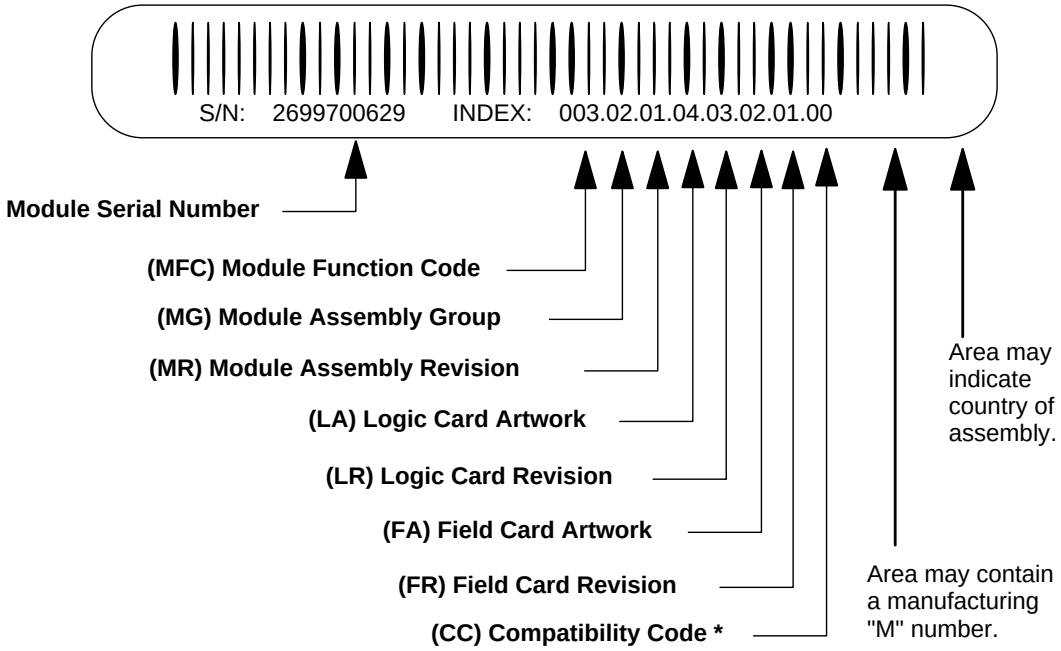
B.3.2 INDEX NUMBER

The 17-digit index number is packed into three 16-bit words. The index number is contained in the M6, M7, and M8 fields of the Module (RM) Record Type and the Node (RN) Record Type (See *Ovation Record Types Manual.)*

Index high word: Index # 3: M8 field (offset d)															
bit 15	bit 14	bit 13	bit 12	bit 11	bit 10	bit 9	bit 8	bit 7	bit 6	bit 5	bit 4	bit 3	bit 2	bit 1	bit 0
MFC	MFC	MFC	MFC	MFC	MFC	MFC	MFC	MG	MG	MG	MG	MG	MG	MR	MR
Index middle word: Index # 2: M7 field (offset c)															
bit 15	bit 14	bit 13	bit 12	bit 11	bit 10	bit 9	bit 8	bit 7	bit 6	bit 5	bit 4	bit 3	bit 2	bit 1	bit 0
MR	MR	MR	MR	LA	LA	LA	LA	LA	LR	LR	LR	LR	LR	LR	FA
Index low word: Index # 1: M6 field (offset b)															
bit 15	bit 14	bit 13	bit 12	bit 11	bit 10	bit 9	bit 8	bit 7	bit 6	bit 5	bit 4	bit 3	bit 2	bit 1	bit 0
FA	FA	FA	FA	FR	FR	FR	FR	FR	FR	CC	CC	CC	CC	CC	CC

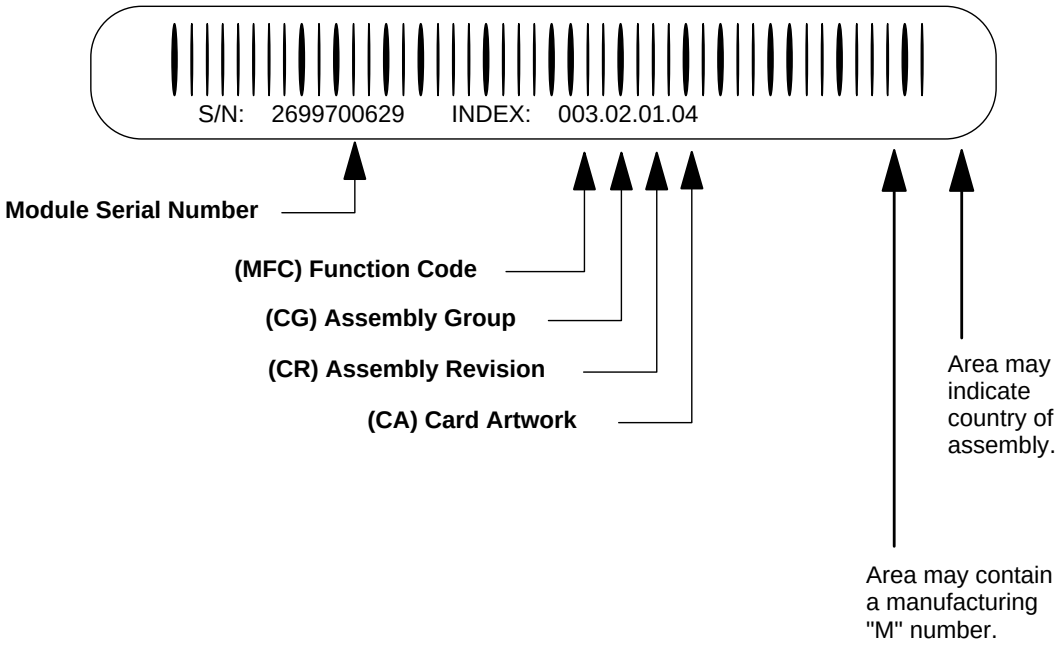
B.4 Bar Code Label

The following figures contain examples of bar code labels. These labels are typically placed on the bottom of a manufactured Ovation Electronics I/O module or I/O Controller board after it has been successfully tested.


S/N: 2699700629 INDEX: 003.02.01.04.03.02.01.00
Module Serial Number
(MFC) Module Function Code
(MG) Module Assembly Group
(MR) Module Assembly Revision
(LA) Logic Card Artwork
(LR) Logic Card Revision
(FA) Field Card Artwork
(FR) Field Card Revision
(CC) Compatibility Code *
Area may indicate country of assembly.
Area may contain a manufacturing "M" number.

* The Compatibility Code applies to select modules only. If no compatibility code is required, then the field is set to "00."

Figure 205: Bar Code Example for I/O Module


S/N: 2699700629 INDEX: 003.02.01.04
Module Serial Number
(MFC) Function Code
(CG) Assembly Group
(CR) Assembly Revision
(CA) Card Artwork
Area may indicate country of assembly.
Area may contain a manufacturing "M" number.

* The Compatibility Code applies to select modules only. If no compatibility code is required, then the field is set to "00."

Figure 206: Bar Code Example for I/O Controller Board

APPENDIX C

CE MARK SPECIFICATIONS

The CE Mark Certified Ovation system uses special EMC cabinets, supplementary internal filtering, and exacting requirements on field wiring and grounding to ensure compliance with specific European Electromagnetic Emissions/Immunity and Low voltage safety.

The CE Mark Certified Ovation Controller cabinet assembly, extended I/O cabinet assembly, and Remote I/O cabinet assembly are certified for operation in the Industrial Environment as documented in the EMC Technical Construction File for Ovation (5A16444) and the Low Voltage Safety Technical File for Ovation (5A26443). The specific requirements for the CE Mark Certified Systems can be located in the following:

- Drawing 5A26418 - This drawing contains a baseline listing of all components applicable for the CE Mark Certified System.
- Drawing 5A26370 - This drawing contains a baseline listing of workstation and peripheral components applicable for the CE Mark Certified System.
- The appropriate *Planning and Installing Your Ovation System* for your system provides information about CE Mark requirements for an Ovation system.

APPENDIX D

USING AN EXTERNAL POWER SUPPLY

D.1 What is an External Supply

Some Ovation I/O modules require an auxiliary power supply. Auxiliary power may be obtained either from the internal auxiliary power supply (backplane), or from an external power supply.

The auxiliary power is bussed along an entire branch of I/O modules. All I/O modules within a branch **MUST** use the same auxiliary power voltage for proper operation. External auxiliary power can be applied to each branch individually.

If an Ovation I/O module is to be connected to an external power supply, perform the following procedure **BEFORE** connecting the power supply to the Ovation module and powering it up.

Note: *We do **NOT** recommend using external auxiliary power with the Relay Output module. Instead, use the Ovation internal auxiliary supply for relay coil power.*

D.2 To Prepare for Connecting an External Power Supply

CAUTION! Using an external power supply may introduce dangerous voltages to an I/O cabinet. Do NOT apply external power to a cabinet until the appropriate internal auxiliary power supply fuses have been removed and the required fuse covers have been installed.

1. Identify the specific I/O branch to which the Ovation I/O module is assigned and the back panel (CBO) or transition panel (ROP or TND) associated with the I/O branch (see **Figure** and **Figure** for panel locations).
2. If the I/O branch is associated with a transition panel, refer to **Figure** and perform the following:
   a) If the transition panel has a cover, remove it in order to expose the fuses.
   b) Remove the pair of round plug-in fuses located nearest the I/O branch that you identified in Step 1.
   c) Replace the transition panel cover (where applicable) after the fuses are removed. A fuse cover kit is not required for transition panels that have a cover. However, if the transition panel does not have a cover, then fuse cover caps (5A26371H20) are required.

Note: *Fuse cover caps are required **only** if the external power supply output voltage is greater than 60 VDC, 42 VAC peak or 30 VAC rms.*

3. If the I/O branch is associated with a backplane (CBO), refer to **Figure** and perform the following:
   a) Identify the artwork level of the backplane.
   b) Determine what fuse cover kit is needed for the backplane:

- ☐ 1C31213G01 for artwork level 3CBO and earlier
- ☐ 1C31213G02 for artwork level 5CBO and later

a) Remove the pair of round plug-in fuses located nearest the I/O branch that you identified in Step 1.

b) Install the appropriate fuse cover kit over the fuse sockets from where the fuses were removed.

Note: *The fuse cover kit is required* ***only*** *if the external power supply output voltage is greater than 60 VDC, 42 VAC peak or 30 VAC rms.*

4. After the fuse covers are securely installed, connect the external voltage power supply positive (+) and negative (-) outputs to the Ovation I/O module base unit terminal block PS+ (A17 or B17) and PS- (A18) terminals. Once the external power supply is connected to the base unit terminal block and is powered up, the entire I/O branch has access to the external power supply voltage.

Note: *Base unit terminal block locations A17 (PS+) and B17 (PS+) are connected to the same potential within the base unit.*

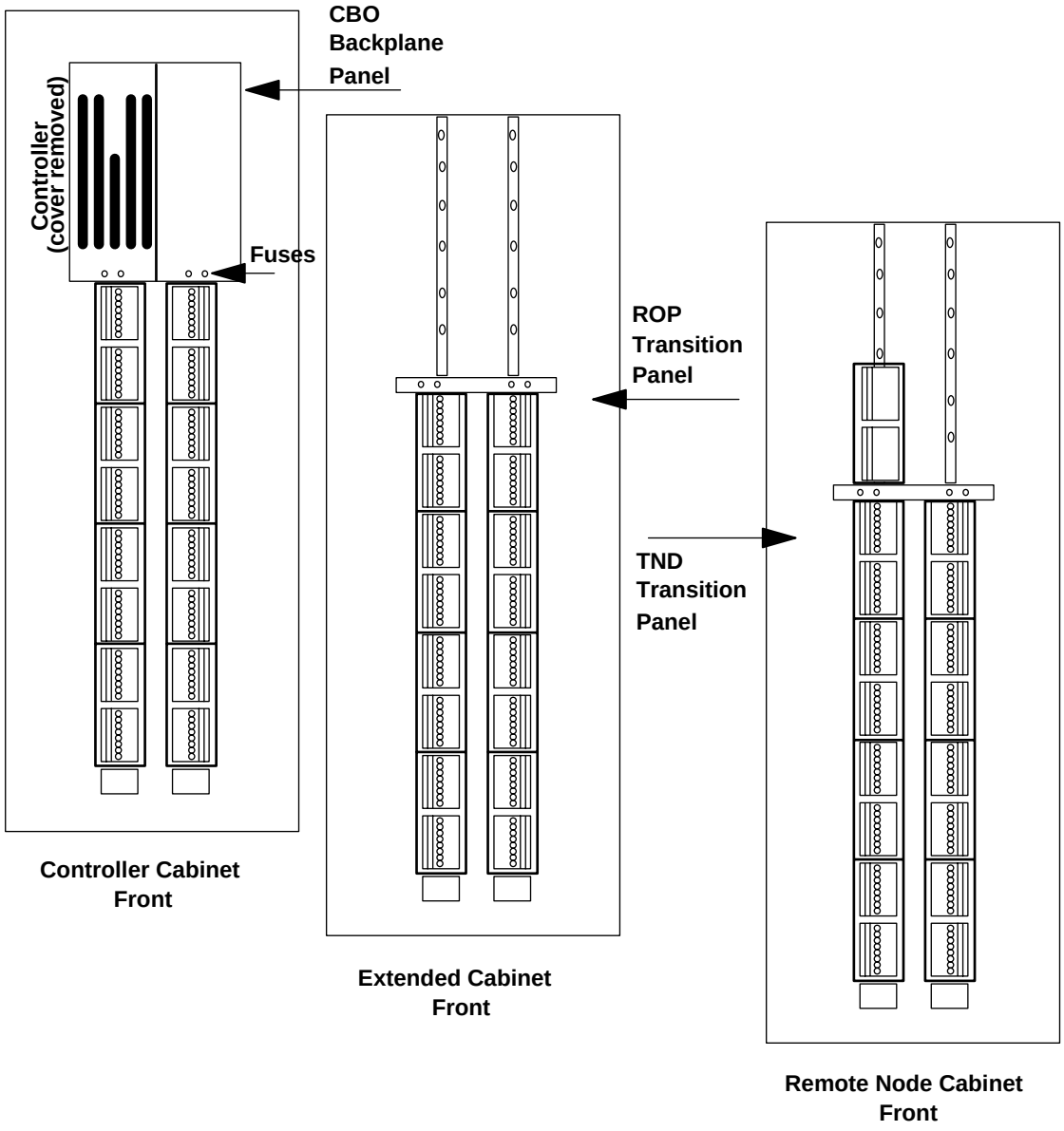


Figure 207: Locations of CBO, ROP, and TND Cabinet Panels

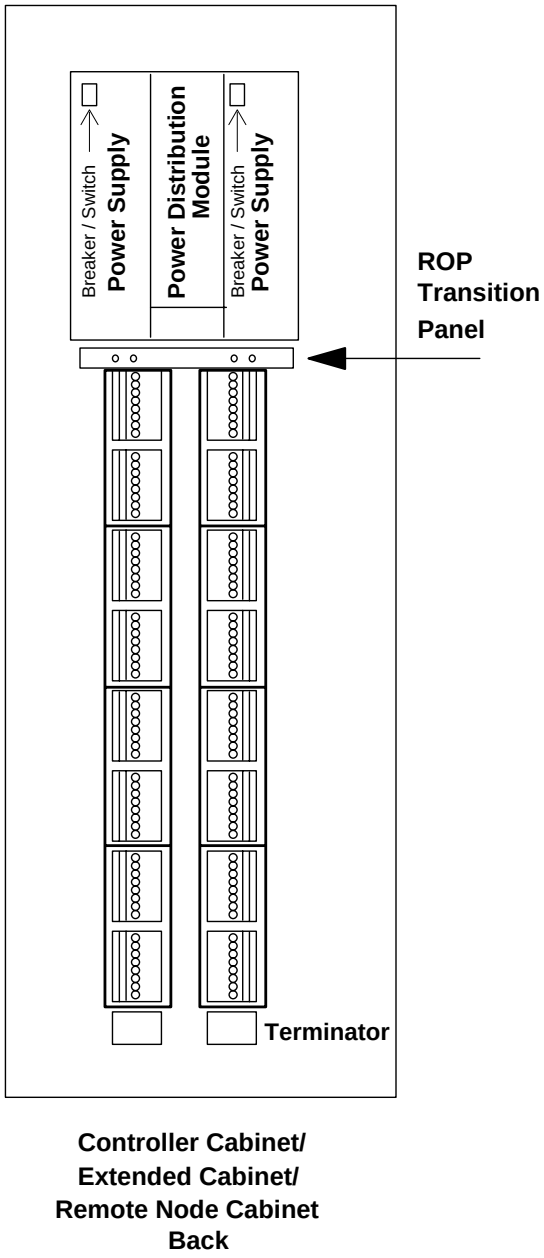


Figure 208: Location of ROP Panel in Cabinet Backs

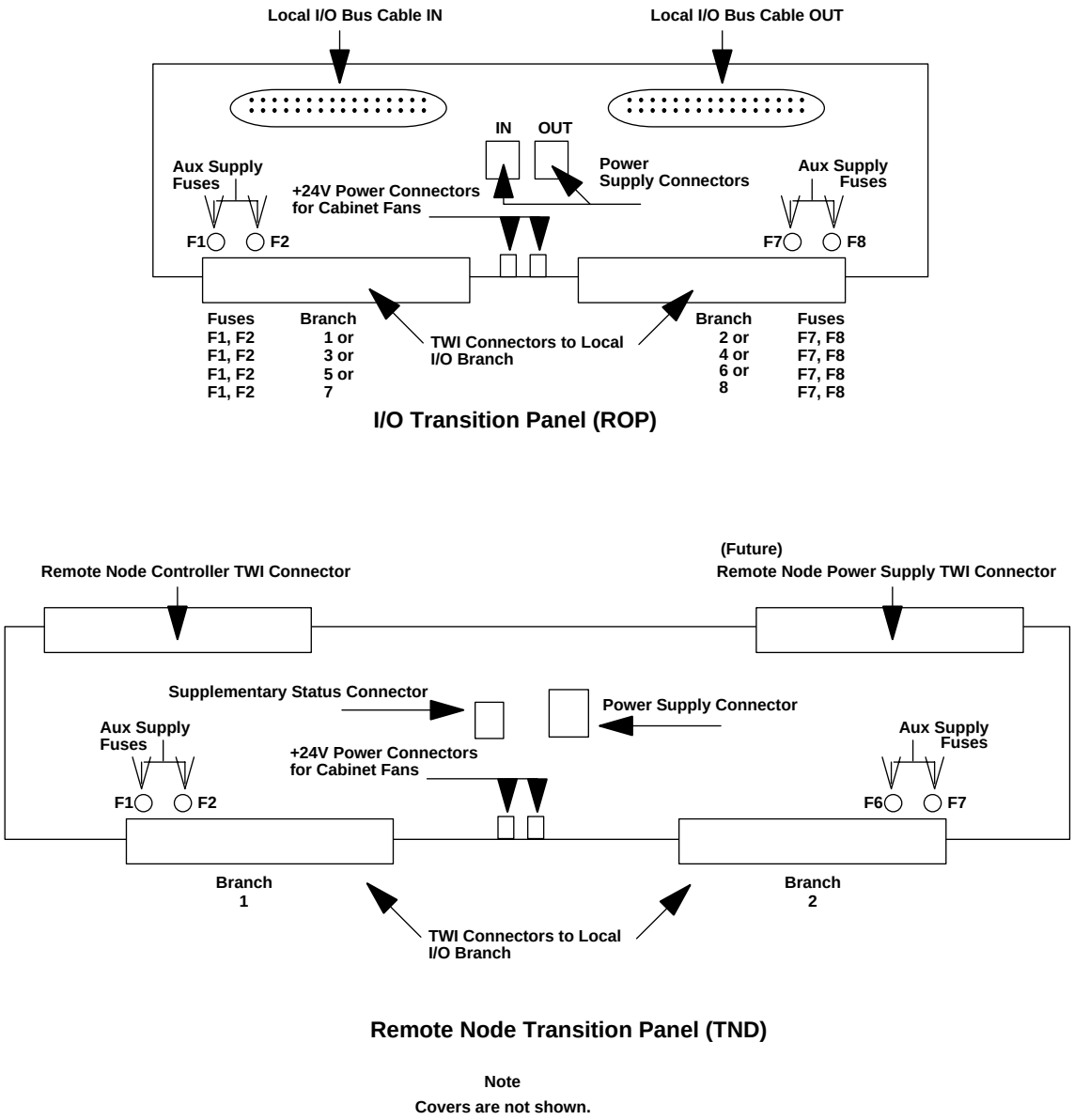


Figure 209: Auxiliary Power Supply Fuse Locations on ROP and TND Panels

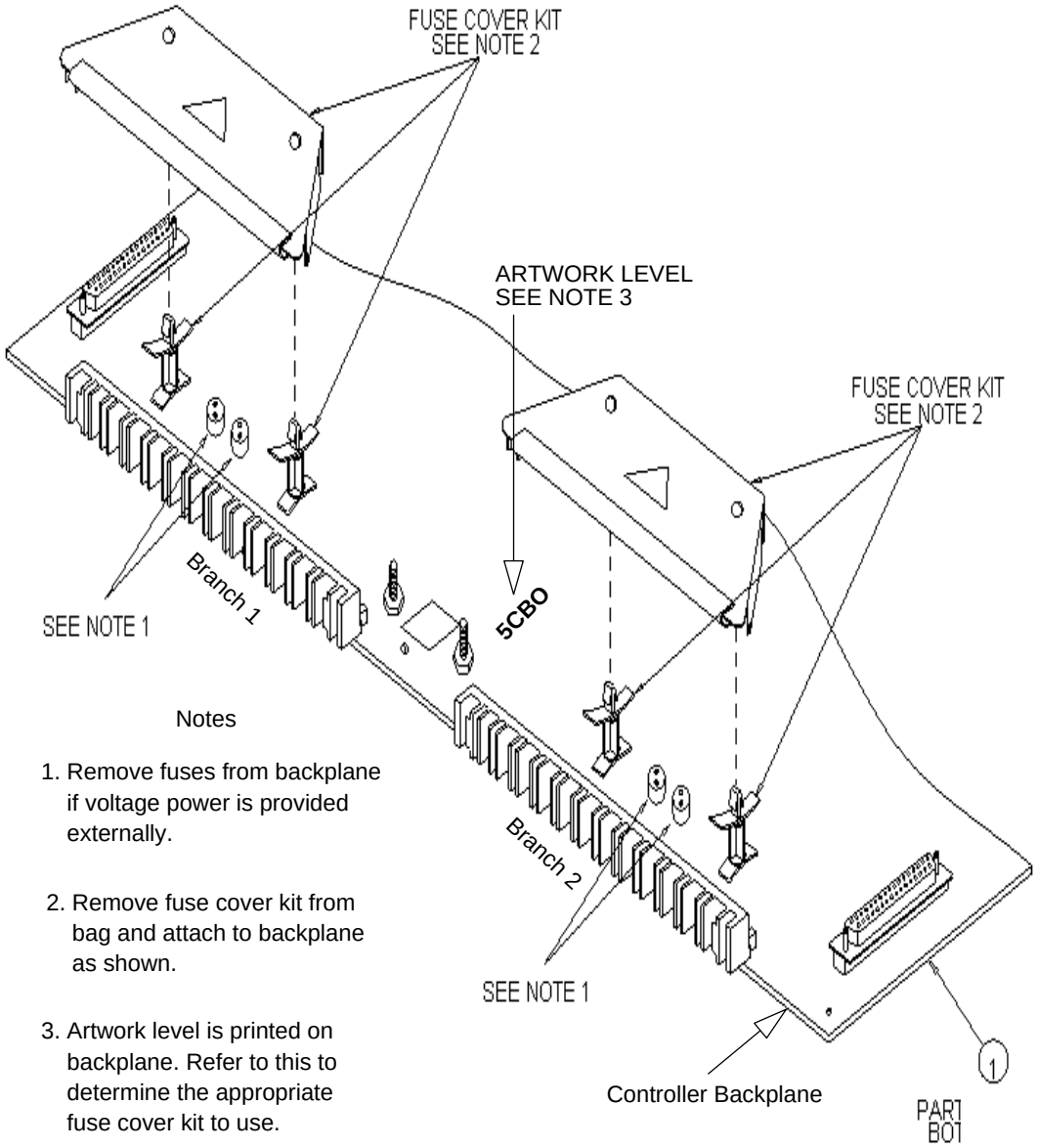

FUSE COVER KIT
SEE NOTE 2
ARTWORK LEVEL
SEE NOTE 3
FUSE COVER KIT
SEE NOTE 2
Branch 1
SEE NOTE 1
5CBO
Notes
1. Remove fuses from backplane if voltage power is provided externally.
2. Remove fuse cover kit from bag and attach to backplane as shown.
3. Artwork level is printed on backplane. Refer to this to determine the appropriate fuse cover kit to use.
Branch 2
SEE NOTE 1
Controller Backplane
PART
BOT

Figure 210: Fuse Locations on Backplane

GLOSSARY OF TERMS

A

A PORT

Port on a dual-attached Ovation station where the primary ring enters and the secondary ring exits.

ADMIN TOOL

The Administrative Tool is an Emerson utility that configures and downloads software to the drops through the use of GUIs. (Do not confuse this tool with the Sun utility also named Admin Tool.)

ALARM

A message or other signal intended to draw attention to a non-normal plant condition; for displays at user interfaces, an alarm reflects a point status.

ALGORITHM

1) A set of rules, procedures, and mathematical formulas that define a desired control strategy.
2) Software provided with a Controller to automatically apply a specified algorithm during the system scan.
3) Ovation record type (LC) used to store tuning or data configuration for an algorithm in the system.

ANALOG

1) Conditions or values that continuously vary across some range, represented by more than one bit.
2) A point that is an analog record type. Analog points are typically associated with I/O hardware that converts a field signal (for example, voltage) to a low-level signal used by the processor. Can be Long or Deluxe (Contrast with digital.)

APERIODIC POINTS

Points whose values are scanned only as needed or as requested. See also periodic points.

API

Application Programming Interface, a set of routines or functions a program calls to tell the operating system to perform a task.

APPLICATION PROGRAM

1) Emerson-supplied programs that perform frequently required functions. 2) A series of loops, ladders, and/or algorithms run in a processor to control plant functions. Also known as an Application. 3) User-defined or commercially available software that performs a specific task.

APPLY

GUI button that accepts changes and window remains open.

ASCII

American Standard Code for Information Interchange, a standard for representing computer characters. The set consists of 128 characters numbered from 0 to 127 and includes all the letters, numbers and punctuation marks.

ASYNCHRONOUS

Data communication that is not time critical. Typically provided on demand only and provided at different times (Contrast with synchronous).

AUI CABLE

Attachment Unit Interface Cable that interfaces the PCRR card to the MAU module in Ovation and WDPF migrated remote I/O applications. It contains four sets of individually shielded twisted pairs.

B

B PORT

Port on a dual-attached Ovation station where the secondary ring enters and the primary ring exits.

BANDWIDTH

This is a description of how much information can be sent through a connection, usually measured in bits-per-second.

BASE ALARM SYSTEM

Standard package used for viewing and acknowledging alarms.

BASE UNIT

Hardware that consists of a printed circuit board, various connectors, and plastic housing and provides a mechanism for the user to land field wiring, and connects the field signals to the I/O module. The unit enables the I/O module to receive power, and also provides a low-impedance earth ground connection. Each Base Unit can house two sets of I/O modules, along with the associated field wiring.

BAUD RATE

Number of bits-per-second a modem can send or receive.

BG

See Packed Group Alarm.

BIT

A single digit number in base-2, either a 1 or a zero. This is the smallest unit of computerized data.

BITMAP FILE

A file type that is used to define which icons will be shown when using iconic alarming.

BOOTSTRAP

A software routine used to start computer operation (sometimes abbreviated 'boot'). The bootstrap routine will typically occur automatically after a reset or power cycle, but may require manual keying.

BRANCH

Set of Base Units configured consecutively on a DIN rail with a local bus being connected to the Ovation I/O controller.

BRIDGE

Device that connects two or more network components and transmits data with source and destination addresses on different network components.

BROADCAST

Process of sending information across the Ovation network. Broadcasts may be periodic (every second or every 0.1 of a second) or non-periodic (broadcast on demand only).

BYTE

A set of bits that represent a single character. Typically, 8 or 10 bits in a byte.

C

CANCEL

GUI button that cancels changes and dismisses window.

CDDI

Copper Distributed Data Interface (See FDDI).

CDE

Common Desktop Environment. A windowing system that runs on a Sun-compatible workstation under SunOs™ or Solaris™

CHARACTERISTICS

A set of 8 alphanumeric characters associated with a point, used to represent user-defined aspects of the controlled process. Characteristics are used in alarm processing and point review/search functions.

CLIENT

A computer, or software program that is used to contact and obtain data from a server software program on a networked computer.

COIL

A ladder diagram element that represents either a real-world output field device (for example, a motor starter, solenoid, etc.) or an internal calculated point. (See discrete output.)

COLLISION

Garbling of data when two or more nodes on the same network segment transmit data simultaneously.

COLLISION DETECTION

Switches are used to buffer simultaneous data messages and transmit them one at a time.

COMPACT I/O MODULES

Ovation I/O modules that do not contain a Personality module, only an Electronics module.

CONCENTRATOR

FDDI node used to connect multiple Ovation stations to dual rings. Must have an “A” port, a “B” port, and at least one “M” port.

CONDUCTING

The state of a ladder diagram circuit when there is a continuous current path condition caused by closed contacts.

CONFIGURATION

Entering initial data into a processor, including definition of associated hardware. The configuration process typically includes downloading the drop database and other required software, and may involve editing configuration files(s).

CONFIGURATION FILE

Typically, an ASCII file containing statements that specify the configuration of a drop or function. These files may use standard operating system formats or may use an Emerson source language.

CONTACT

A ladder diagram element that represents either a real-world input device (for example, a push-button, switch, etc.) or an internal calculated point. (See discrete input.)

CONTROL BUILDER

AutoCAD based Power tool package used to build control drawings and generate source code from the drawings.

CONTROL SHEET

AutoCAD drawing that contains a graphical representation of a control scheme.

CONTROL TASK

Specific Controller area where all control sheets in that area are scanned at the same frequency.

CONTROLLER

A drop used to control a process. The Controller passes process control information over the network to other drops or devices that need it.

CPU

Central Processing Unit, a microprocessor chip that powers a computer. May also refer to the case that holds the chip.

CRT

Cathode-Ray Tube, a tube of a monitor that produces images on the screen. Often used as a generic term for a computer monitor.

CURSOR

A character on a display screen indicating the current active location.

D

DAC/DAS

Dual Attachment Concentrator/Dual Attachment Station. Provides dual attachment to the FDDI or Fast Ethernet network.

DATA HIGHWAY

The communication link used to transfer time-critical information between drops or stations; also called a Local Area Network (LAN) or network.

DATA STRUCTURES

Four portions of an Ovation point record type.See also Dynamic Data, Static Data, Flash Data, and MMI Data.

DATABASE

A structured set of data, especially the point database in each Ovation drop (which defines originated and received points) and the Ovation master database (which defines the attributes of all points in the system).

DCS

Distributed Control System (such as Ovation).

DEADBAND

Range of values through which an input signal may vary without initiating an action that causes an observable change in the output signal.

DEFAULT POINTS

Points created by the Control Builder that have a defined naming convention.

DEFAULT VALUE

Used by a program when no specific value has been entered by the user. In the context of an iterative window or program, default may refer to a value specified in the function's configuration file; in the context of configuring a function, default refers to the value used when there is no valid parameter entry.

DELUXE RECORD TYPE

Optional Ovation record type. Has same functions as Long record type, plus plant mode limits and scan time displays.

DESTINATION

1) The location in memory (such as a holding register) into which data is placed after the completion of certain programmable functions. (Contrast with source.)
2) A method of determining which alarms will be displayed at a specific user interface drop, based on the first point characteristic (typically representing the plant area).

DEVELOPER STUDIO

Common interface that houses all of the integrated engineering tools necessary for a Microsoft Windows based Ovation system.

DEVICE

1) Peripheral equipment connected to the Ovation system.
2) Algorithm specifically designed to simplify operation of open/close or stop/start devices, using feedback signals to monitor command completion.

DHC

Data Highway Controller. Printed-circuit board(s) in each drop that manage Data Highway communication.

DIAGNOSTICS

Functions that examine hardware or software to isolate malfunctions and errors. In the Ovation system, each drop incorporates automatic self-test diagnostics. If faulty operation is detected, a message or alarm is usually initiated.

DIAGRAM

A graphic depiction ofa plant process (or other data), displayed on a CRT at a user interface.

DIALOG BOX

A user interface window that prompts the user to enter information needed by a process.

DIGITAL

1) Signals or conditions that are either on or off, represented by one bit.
2) A point that is a digital record type. Digital points are typically associated with discrete I/O hardware. Can be Long or Deluxe. (Contrast with analog.)

DIN

German standards organization (Deutsche Industrie Norm).

DIP

Integrated circuit enclosed in a plastic or ceramic housing and connected to pins. (Dual Inline Package)

DISCRETE I/O

Individual hard-wired circuits connecting real-world field devices with the processor. Each discrete input provides the processor with a single digital signal based on a single state in the field device. Each discrete output sends a single digital signal to the field based on a single bit of data in the processor.

DISTRIBUTED DATABASE

Contains a subset of the information stored on the Master Database and is stored locally on a drop to allow that drop to operate if the Master Database is unavailable. A Distributed Database is present on each drop in the system and is continually updated as point information changes.

DISTRIBUTED I/O

Hardware used to communicate between the processor and I/O modules located outside the processor chassis (also called Remote I/O).

DOMAIN

Logical collection of computers and users on a network that share a common security database.

DOWNLOAD

The process of transferring data to the memory or disk of a drop.

DROP

A collective term for a Controller, Workstation, or Database Server that is a member of an Ovation network and is defined as a drop by an Ovation configuration tool (Developer Studio or Init Tool).

DROP LOADER

Power Tool used to load control and originating point information into drops in an Ovation system. Links the Master Database with all the drops in the system.

DROP POINT (DU)

Record type used to store status information for a drop. Every drop must be configured with at least one point of type DU.

DYNAMIC DATA

Portion of an Ovation point record that is broadcast periodically in Dynamic Data Blocks (DDBs)by the originating drop and stored in volatile memory. DDB size is configured through the Ovation configuration tools (Admin Tool or Developer Studio).

E

EDB HISTORIAN

A drop on an Ovation control system that will collect, process, archive, and retrieve information that originates locally or throughout a geographically diverse set of process control sites.

ELECTRONICS MODULE

Part of Ovation I/O that contains the electronics for processing I/O signals. Fits into the Base Unit and is typically configured by a Personality Module.

EMS

Expanded Memory Specification, a bank-switched memory management scheme that allows applications to access vast quantities of memory.

ENGINEERING STATION

An Ovation drop used for configuration and entry of system programs.

ETHERNET

A standard network protocol. Used to transfer non-time-critical information between drops.

F

FAST ETHERNET

Standard for transmitting data at 100 megabits per second. Similar to FDDI, but uses switches instead of concentrators, and dual-channel Ethernet NIC cards instead of dual-attachment FDDI NIC cards (Contrast to FDDI).

FDDI

Fiber Distributed Data Interface, a standard for transmitting data. Typically consists of a dual fiber-optic counter-rotating ring capable of carrying synchronous and asynchronous messages. Ring provides automatic “wrap-back” reconfiguration if a segment of the highway fails (Contrast to Fast Ethernet).

FIREWALL

Security system intended to protect an organization's computer network from external threats. All communication between the internal computer network and the outside world is routed through a server that determines if a message is safe to pass to the internal network.

FLASH DATA

Portion of an Ovation point record that is stored in the originating drop’s flash (or disk) memory and copied to receiving drop’s periodically.

FORCE VALUE

To set the value of a coil or contact to a desired state (on/off; 0, 1), regardless of other values in the ladder diagram.

FOUNDATION FIELDBUS

Digital, two-way, multi-drop communication link among intelligent measurement and control devices.

FTP

File Transfer Protocol, a set of rules that allows one computer to download a file from another computer via a network connection.

FULLY QUALIFIED POINT NAME

Point name that specifically identifies a point by combining three parameters. Format is **pointname.unit@network** where point name contains a maximum of 16 characters, unit contains a maximum of 6 characters, network contains a maximum of 8 characters. Do not use when inserting a new point in Developer Studio, only insert point name parameter.

G

GATEWAY

Hardware or software that translates between two dissimilar protocols.

GP

See Packed Group.

GRAPHICS BUILDER

Power Tool used to create and edit System Process Diagrams that display on the Operator Station.

GUI

Graphical User Interface, an industry-standard term used to describe a user interface based on a windowing system such as Microsoft Windows™.

H

HISTORIAN

Dedicated drop in the Ovation system that collects and stores process point data and other information.

HMI

Human Machine Interface. Refers to drops that provide user interface functions.

HOST

Any computer on a network that is available for services to other computers.

HYPERTEXT

Any text that contains “links” to other documents-words or phrases in the document that can be chosen by the reader and which cause another document to be retrieved and displayed.

I

I/O

Input/Output, a general term for reading and writing data on a computer. Digitizes information from plant processes and passes it to the Controller for use in control strategies.

I/O BUILDER

Power Tool used to define the I/O modules used in an Ovation system.

I/O CONTROLLER

Interface between the Network and the I/O. The Controller is located in the Ovation I/O cabinet.

I/O MODULE

Typically made up of an Electronics module and a Personality module. Performs the interface between the I/O Controller and the field devices.

I/O NODES

Ovation record types

ICON

A small graphic on a windowing system display that represents an active process or available function. Typically, an icon can be expanded into a window.

ICONIC ALARMING

Provides a mechanism to group alarms based on their priority and their plant area. Each group of alarms is represented by a preconfigured bitmap on the display.

INIT TOOL

Initialization Tool. Ovation utility that defines the system drops and the software packages on the drops through the use of GUIs.

IOIC CARD

Generic name for the Ovation I/O Interface card. Also known as PCI card. Options are PCQL, PCRL, and PCRR cards.

IP ADDRESS

A unique number consisting of 4 parts separated by dots, (for example, 129.228.36.38). Every computer that is on the Internet has a unique IP address.

ISA

Industry Standard Architecture, the 8- and 16-bit bus design used in most PCs.

K

KB

Kilobyte, A thousand bytes, (actually 1024 bytes).

L

LADDER

1) A diagram representing relay-type control logic (see coil, contact).
2) The user's control application program written in a variation of relay logic representation.

LAN

Local Area Network, A computer network limited to the immediate area, usually the same building.

LICENSE

A necessary permission to use certain Emerson Process Control software products.

LOG SERVER

Utility used to define and modify custom reports for an Ovation system. Also known as Report Builder or Report Server.

LOGIN

1) The account name used to gain access to a computer system.
2) The act of entering into a computer system.

LONG RECORD TYPE

Default record type for Ovation points. Has full alarming and I/O capabilities.

LOOP

1) A diagram representing a modulating or continuous process control.
2) The modulating control system for a particular physical process.

LOOP INTERFACE MODULE (LIM)

M/A Station interface connected to QLI card.

M

M PORT

Port on a Concentrator that attaches to a drop or station.

M/A STATION

Manual/Automatic Station. May be a diagram (sometimes called a “soft” M/A Station) that simulates the functions of a traditional panel-mounted control device. The M/A Station allows the operator to select manual or automatic control of the output, and to manipulate the set point or output value (depending on the selected control mode).

MAN PAGES

UNIX on-line documentation for operating system functions. Type “man” and the desired topic.

MASTER DATABASE

Contains the entire process database. It is used for creating, modifying, and verifying control strategies and process points. At runtime, it supports queries of the process database, captures changes made to control and point attributes, and propagates those changes to the distributed database.

MAU

Media Attachment Unit. Interfaces the PCRR card (via the AUI cable) to an Ovation RNC card or a WDPF QOR card.

MB

Megabyte, A million bytes, a thousand Kilobytes.

MENU

A screen display representing a set of functions available to the user.

MIGRATION

Process where Q-Line I/O is interfaced to an Ovation Controller.

MMI

Man-Machine Interface. Refers to drops that provide user interface functions (such as the Operator Station).

MMI DATA

Portion of the Ovation point record that is saved in the Distributed Database in every Ovation workstation.

MODEM

MOdulator and DEModulator, A device that connects to a computer and to a phone line that allows the computer to talk to other computers through the phone system.

MODULE POINT (RM)

Ovation record type used to configure and monitor status of Ovation I/O modules.

MONITOR

1) To observe the operation of a process without influencing it.
2) A computer terminal or CRT.

MULTIPLE NETWORKS

Function that enables separate Ovation Networks to communicate with each other, share data, and perform control actions.

N

NETWORK

Two or more computers connected together so they can share resources.

NETWORK FOLDER

A subfolder of the System folder in the Ovation Developer Studio. Only one Network folder can exist in the system. The Network folder is the parent folder to all files, objects, and folders that pertain to the Network.

NIC

Network Interface Card. Located in Ovation Controller cabinets, Stations, or HMIs.

NODE

1) Any single computer connected to a network.
2) Active element on an FDDI or Fast Ethernet network that has an address. Can be a station or a concentrator. Up to 1000 nodes are permitted per network.

NODE POINT (RN)

Node point is used to configure and monitor PCRL, PCRR, PCRQ cards, and remote I/O nodes.

O

OPENWINDOWS

A windowing system that runs on a Sun-compatible workstation under SunOs™ or Solaris™.

OPERATOR STATION

A drop in an Ovation system used to control and monitor plant operation.

ORIGINATED POINTS

Points that were created in the current drop.

OVATION I/O

Line of Emerson I/O modules.

OVATION KEYBOARD

Also known as the Membrane Keyboard, a specialized keyboard that is connected to an Ovation Operator Station serial port and allows the user to execute a set of standard functions from the keyboard.

OVATION NETWORK

Redundant, deterministic, high-speed network used for process control. Based on Fast Ethernet standards, it supplies input and output data to all the stations and Controllers connected to it.

OVATION SYSTEM

An open architecture Emerson Process Control System that is based on ANSI and ISO network standards. Uses snap-in modules for I/O.

P

PACKED DIGITAL POINT (PD)

A point that is a packed digital record type. Holds either 32 separate digital values or two 16-bit register (analog) values.

PACKED POINT

A point that is a packed point record type. Packs up to 16 digital (logical) bits in one point record. Each bit may be separately configured for I/O scanning. Can be Long or Deluxe.

PASSWORD

A code used to gain access to a locked system.

PC

1) Common acronym for personal computer
2) Common acronym for programmable controller.

PCI

Peripheral Component Interconnect. Generic name for the Ovation I/O Interface card. Also known as IOIC card. Options are PCQL, PCRL, and PCRR cards.

PCL

Printer Control Language. Printer language that drives most laser and inkjet printers.

PCQL CARD

Ovation IOIC card used to interface with Q-Line modules.

PCRL CARD

Ovation IOIC card used to interface with local Ovation modules.

PCRR CARD

Ovation IOIC card used to interface with remote Ovation modules and remote Q-Line I/O modules in migrated systems.

PDS

Process Diagram System. Contains graphics that are displayed on the Ovation Operator Station.

PERIODIC POINTS

Points whose values are scanned periodically at a defined frequency such as every 1 second or every 0.1 of a second. See also aperiodic points.

PERSONALITY MODULE

Part of Ovation I/O that configures the Electronics Module. Fits into the Base Unit beside the Electronic Module that it configures.

PID

Proportional, Integral, Derivative. A type of closed-loop, modulating control function. It acts according to an algorithm that detects deviations between a predetermined set point and an actual process variable input condition or value.

PLANT MODE

Defines the current state of a plant (value range 1 - 6). Alarm limits can be defined that are based on plant mode. Can be defined in Deluxe points.

POINT

A record in the Ovation master database containing a value (such as an input or output) and related data.

POINT BUILDER

Power Tool used to create, modify, and delete Ovation points.

POKE FIELD

A location in a diagram where the cursor can be placed, allowing the operator to select an option.

PORT

1) A connection where information goes into or out of a computer.
2) Translating a piece of software to bring it from one type of computer system to another.

POWER TOOLS

Set of unified and flexible engineering tools used to configure and maintain the Ovation system. All objects (such as points) created by the tools are stored in a master database.

PROCESS DIAGRAMS

Graphical images that represent actual plant process control equipment. Part of the Process Diagram System (PDS) used at the Operator Station.

PROCESSING TIME

The time, in milliseconds, required to make one complete pass through a Controller application program.

Q

Q-LINE

Legacy line of Emerson I/O modules.

QUALITY

Indicates point condition to Operator Station and to the algorithms.

R

RADIO BUTTON

Button appears as a small circle that, when selected, has a smaller, filled circle inside it. Selecting one button in a set deselects the previously selected button so one and only one of the options in a set can be selected at any given time.

RAM

Random Access Memory, the generic term for memory that can be written to and read from.

RECEIVED POINTS

Points that were not created in the current drop.

RECORD

The set of data associated with a point, including the point name, System ID, value, status, and various other fields, depending on the point record type.

REFRESH

Refreshes the display to the current contents of the object's database values.

REGISTER

A data storage area in memory. In the Controller, there are four types: input registers (R), output registers (O), holding registers (H), and dynamic holding registers (G). At times, however, input groups (I) and output groups (C) are used as if they were an input or output register.

RELATIONAL DATABASE

Central database (Oracle) for Ovation systems. Uses tables to store and locate information.

REMOTE I/O

A hardware configuration where the I/O is located remotely from the Controller.

REMOTE NODE

A grouping of I/O modules that communicates with the Controller via media that can carry control signals over a long distance (for example, fiber-optic).

REVIEW

Data retrieved from the Ovation network. Reviews can be retrieved based on point status requests and/or point characteristics.

RING

Set of nodes where data is passed sequentially between nodes, examined or copied, and returned to the originating node.

RISC

Reduced Instruction-Set Computing, a microprocessor architecture that contains a smaller instruction set in order to increase processor speed.

RNC

Remote Node Controller (RNC) is an alternate name for the Ovation module containing the Remote Node Electronics module and Remote Node Personality module. The RNC interfaces the I/O modules in the Remote Node to an MAU module at the Controller via a fiber-optic communication link

ROM

Read-Only Memory, the generic term for memory that can read from but not be written to.

ROP

I/O hardware transition panel.

ROUTER

A hardware or software set-up that handles the connection between two or more networks.

S

S PORT

Port on a station that connects to an M port.

SAC/SAS

Single Attachment Concentrator/Single Attachment Station. Provides a single attachment to the FDDI or Fast Ethernet network.

SCAN

The processor module's sequential and ongoing examination of each contact circuit, control relay, special function, and process control loop in the application program. During the scan, the processor accesses data stored in memory and the current states of the field I/O. The result is the energizing or de-energizing of the coils and the determination of analog output information.

SCSI

Small Computer System Interface, a peripheral-connect interface used to connect hard drives, CDROM drives, and other storage devices to a computer.

SECURITY BUILDER

Ovation Power Tool that defines, configures, and manages security for an Ovation system.

SELECT

1) For control applications, choosing the algorithm to be controlled, typically through an M/A Station.
2) Highlighting an item on the screen, such as an item on a menu or in a scrolling list, as a means of choosing an option.

SERVER

A computer, or software program that provides a specific kind of service to a client software running on other computers.

SETPOINT

The desired value of a process variable. In modulating control, other variables are continuously modified to maintain the value of the controlled variable at the setpoint.

SGML

Standard Generalized Markup Language, a text-based language for describing the content and structure of digital documents.

SID

See System ID.

SIMULATOR

Software package that runs on an actual Ovation Controller. Can use either simulated or actual I/O hardware to test control logic.

SMARTPROCESS

Emerson's plant optimization software used to improve plant processes.

SNMP

Simple Network Management Protocol. An Ovation program designed to monitor and report the activity in various devices on the network.

SOE

Sequence of Events. SOE messages are transferred from Controllers to certain drops on the network.

SOFTWARESERVER

A drop on a network that provides storage and control of system software files.

SOURCE

1) A location, in memory, that is the origin of the data to be moved or converted. This may be a register or, at times, an input group used as a register.
2) An ASCII input file containing commands or statements in a programming language.

STATIC DATA

Portion of the Ovation point record that is stored in volatile memory by the originating drop and broadcast to receiving drops on an as-needed basis. The receiving drop stores it in its volatile memory.

STATION

Addressable node on FDDI or Fast Ethernet network; can transmit, repeat, and receive data.

SVGA

Super Video Graphics Array, an extension of the VGA video standard. SVGA enables video adapters to support up to 16.7 million colors, known as true colors in a 1024-by-768 pixel display.

SWITCH

Fast Ethernet device used to connect multiple Ovation Stations to the network.

SYNCHRONOUS

High speed data communication that is time critical. Must be guaranteed service for nodes transmitting synchronous data. Typically provided periodically.

SYSTEM FOLDER

The parent folder to all files, objects, and folders that pertain to that System in the Ovation Developer Studio.

SYSTEM ID

System Identification number (SID). The Data Highway reference number for each point which may be transmitted.

SYSTEM TREE

The system file structure in the Ovation Developer Studio.

T

TCP/IP

Transmission Control Protocol / Internet Protocol, a set of communication protocols that allows dissimilar computers to share information over a network.

TERMINAL

1) Solaris window where commands are entered.
2) A device that allows the user to send commands to a remote computer.

TIFF

Tagged Image File Format, a file format for bit-mapped graphics that stores the information in discrete blocks called tags.

TND

Remote Node transition panel.

TOKEN

A field in the Drop Status Record (DSR) that identifies the drop that broadcast a message.

TOOLBAR

A row of icons that activate commands or functions when clicked.

TREND

A display that plots point values over a selected time interval. Trend displays may be generated based on data from the MMI trend history, from a Historian, or from an eDB.

TUNING

Manually changing the value of point record fields or algorithm record fields.

U

UNIT FOLDER

The subfolder of a Network in the Ovation Developer Studio. The Unit folder is a parent folder to all files, objects, and folders that pertain to that particular unit.

UNIX

An operating system used in Ovation drops. Ovation uses the Solaris version of UNIX.

V

VGA

Video Graphics Array, a standard graphics adapter that enables video adapters to support 16 colors in a 640-by-480 pixel display.

VIRTUAL CONTROLLER

Software representation of an actual Ovation Controller, but no Controller hardware is required. Virtual Controllers have the same functionality as real Controllers, but do not actually connect to plant I/O.

W

WINDOW

A screen display using only part of the CRT, often movable and resizable.

WINDOWS

Microsoft 32-bit multitasking Operating System (such as NT or XP).

WYSIWYG

What You See Is What You Get, when the appearance of the screen output matches exactly (or very closely) the printed output.

Z

ZOOM

A way of enlarging or reducing a specific area in a graphic.

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